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WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY.
E. A. BIRGE, Director.

BULLETIN NO. 1. ECONOMIC SERIES NO. 1.

ON THE

# FORESTRY CONDITIONS

OF

# NORTHERN WISCONSIN

BY

FILIBERT ROTH,
*Special Agent United States Department of Agriculture.*

MADISON, WIS.
PUBLISHED BY THE STATE
1898

# Wisconsin Geological and Natural History Survey.

BOARD OF COMMISSIONERS.

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of Wisconsin made by the Division of Forestry, the result of a canvass in which your Survey co-operated financially and otherwise.

I take occasion at the same time to express the hope that the showing herein made regarding the conditions of one of the most important resources of your state, will in this very jubilee year of semi-centennial existence of the state, lead to a serious consideration and inauguration of a more conservative policy touching your forest resources.

The interests of agriculture, as well as of many other industries in your state, demand timely attention to this problem.

Respectfully,
James Wilson,
Secretary.

In giving this report to the public the Geological and Natural History Survey echoes the hope of the Secretary of Agriculture that the material here presented will aid in the formulation of rational forestry legislation, and so will help to develop and restore the great forest resources of the State of Wisconsin.

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# FOREST CONDITIONS OF NORTHERN WISCONSIN.

The preliminary forest survey of Wisconsin, the principal results of which are here presented, was necessarily made in the form of a census or canvass, collecting the knowledge of the woods, and the experience in actual logging operations of several hundred men, and securing a better interpretation of this information as well as a proper insight into the forestal conditions, not usually observed by woodsmen, by personal inspection of typical localities in every county.

From this it follows that all estimates of areas and yields represent the knowledge of the best informed men, and a fair degree of correctness may be claimed for the same for the reason that each district, at least every county, is represented by a number of competent men, the writer being enabled by personal inspection to weigh, verify, or harmonize conflicting statements. The greatest help came from the practical woodsmen, who, in all parts of the territory, kindly assisted both by verbal information and by the use of their exhaustive "minutes," many of which fill volumes, and represent an amount of detail information such as exists for but few parts of our country.

In this connection it gives the writer pleasure to express his sincerest thanks to all these gentlemen, whose help alone could insure reasonable success to so hasty reconnaissance. The journey through the State occupied over three months, involved one or more trips over nearly every mile of railway passing through this section, besides several hundred miles of travel by wagon. The county-seat of every county was visited and no county received less than two days' attention.

During the first part of the journey the writer was accompanied and greatly assisted by Prof. L. S. Cheney, of the State University.

Hearty thanks are due to J. T. Cleveland, Land Commissioner of the Chicago and Northwestern Railway, W. H. Killen, Industrial Commissioner of the Wisconsin Central Lines, and especially to L. Jackson, Industrial Commissioner of the Chicago, Milwaukee and St. Paul Railway, whose courteous assistance did so much to facilitate this work.

## PHYSIOGRAPHY OF THE AREA.

The territory covered is that part of the State lying north of a line from Green Bay to the mouth of the St. Croix river, with the counties of Portage, Wood, and Jackson as southern projections; it involves 27 counties with a total land area of about 18.5 million acres or about 53 per cent. of the entire State, and contains almost all of the present supplies of lumber sized timber of both pine and hardwoods remaining in Wisconsin.

*Topography.*—Over 90 per cent. of this territory is a broad slope, which rises gently from the southeast, south, and southwest to a flat divide running near to and parallel with the south shore of Lake Superior; about 9 per cent. is occupied by the more abrupt slope from this divide to the lake.

In going from east to west, the divides between the several large rivers which drain the larger slope, are very gradual, almost imperceptible, and in some cases are entirely lost in labyrinths of lakes and swamps. Hills over 300 feet high from their base are scarce; a few "mounds," or isolated steep hills with extremely narrow bases, rise out of the sandy plains of Jackson and Clark counties and a few larger, more massive hills occur in the valleys of the Wisconsin, Chippewa, and St. Croix rivers and a range of low, broad hills form the crests of the Iron and Copper ranges. On the whole, however, the hills and hilly tracts do not occupy over 5 per cent. of the total area, while about 45 per cent. is level upland, and about 50 per cent. is rolling country, of which a considerable portion is steeply rolling, "kettle," or "pot hole" land.

*Soils.*—The greater part of this area is covered by deep grayish clay and loam soils, bearing everywhere a forest of mixed hardwoods, or of hardwoods and conifers. A narrow belt of fertile "red clay" lands skirts Lake Superior and is stocked with a unique mixture of conifers and hardwoods, remarkable in the species which are associated and resembling more the regular pinery of the sandy lands than the mixed woods of the loamy soils. A very variable mixture of loam and sandy loam overlies the land about Green Bay, also parts of Chippewa, Dunn, Barron, and Polk counties. About Green Bay this land bore a very heavy forest of pine with a fair mixture of hardwoods; in the western counties part of it was openings and part bore heavy pine forests. Throughout this area the presence of sand is indicated by the characteristic white birch. Sandy lands, continuous with the sands of Waushara, Adams, and Juneau counties, form the southern edge of this district through Portage, Wood, Jackson, Clark, Chippewa, and Dunn counties. These sandy lands are either oak and jack pine openings, i. e., brush prairies scatteringly covered by low brushy oaks and dense groves of small jack pine, or else the were regular pinery covered by a dense stand of valuable pine, without hardwoods.

Within the large loam land area there occur three islands of sandy soil rather well defined, and in most places sharply marked. One of these, the "St. Croix Barrens," extends in a belt 10-20 miles wide from the northwest corner of Polk county to the peninsula of Bayfield; the other a V shaped tract with its southern apex near the junction of the Tomahawk and Wisconsin rivers and occupying the greater part of Oneida and Vilas counties, and the third a broad belt like the first, extending from the Menominee river to about Lake Shawano and occupying the central part of Marinette and a broad strip through Oconto and part of Shawano counties.

In the aggregate the four several sandy districts occupy over one-fourth of the entire area under consideration; they are generally pine lands proper, being covered with dense and almost pure forests of pine, both white and red (Norway) and only in small part stocked with jack pine. The grayish to reddish-gray soil and subsoil of these sandy areas are not generally differentiated. They are usually of great depth, of medium to fine grain and over more than two-thirds of the area contain sufficient clayey matter to deserve the name of loamy sand. These soils support a luxurious growth of pine, but are unsuited to hemlock and hardwoods, which latter are represented only by the white birch, poplar, aspen, and some stunted maple. The most characteristic plants of the cut-over lands of these sandy areas are the jack pine, scarlet oak, and sweet fern, while the white birch is common to all loamy sands but does not thrive on the poorest soils.

The districts of sandy loam before mentioned occupy about 15 per cent. of the total area. They border, for the most part, on the sandy lands fringing this territory on the south, and are mere modifications of the same. The soil in these districts though generally quite fertile is extremely variable, quite heavy in places, often very sandy, and is covered in numerous small and large patches by layers of black muck which greatly increase their fertility. The soil and subsoil of the large body of gray loam and gray clay lands are usually more or less well defined and generally there is found a small amount of humus cover. In most localities the subsoil, especially of all knolls, etc., is mixed with gravel, which occurs either in layers of irregular thickness and distribution or else is mixed promiscuously through the ground. Generally, too, stones or boulders of large size (4 inches to 50 inches) occur both on top and in the ground, which though quite abundant in places do not on the whole, interfere with agriculture, but are even regarded as an indication of good land. The mixture of gravel and loam or clay is extremely variable and in places sufficient sand and fine gravel appears on the surface to make a soil classification quite difficult.

These general outlines will require much modification in a detailed description. Strips of sandy land follow up the rivers, especially the Wisconsin and its tributaries, small islands of loamy soils occur in all three of the large sand districts, while patches of heavy clays and lighter gravelly soils occur in all portions covered by gray loams. The swamps include all poorly drained tracts, either stocked with tamarack, cedar, spruce, or bare grass marshes and moss bogs. They occupy nearly 12 per cent. of the area. They have for the most part a clay bottom, and furnish a good soil, especially suited to hay crops.*

Grouping the land from the farmers' standpoint, it would appear that about 20 per cent. of the area is good farm land, about 40 per cent. medium, while nearly 40 per cent. is either not at all suited to farming or only doubtfully so and should by all means be left to forest. In such classification great divergence of opinion naturally prevails. Most estimates increase the proportion of good farm land at the expense of the medium land, but we have preferred to adhere to the above conservative classification.

*Climate and Drainage.*—The climate is cold, the winters are long, springs almost wanting, summers short but warm and the fall long, cool, and delightful. To illustrate the climate it may be said that the black walnut and hickories are wanting, the timber oaks, both white and red oaks, are replaced by birch in all but the southern and southwestern part of this territory. Corn is raised with difficulty except in the south and the drier western part, while fruit trees, even apples, do not prosper in the greater part of North Wisconsin. The precipitation over the State is about 32 inches per year of which 60 per cent. falls in summer and autumn. The territory under consideration is well supplied with streams and has a far better drainage than is generally supposed.

---

*For a fairly accurate account and map of the soils of this state see the account by Prof. F. H. King in the Settler's Handbook of Northern Wisconsin, by W. A. Henry, Dean of the College of Agriculture, University of Wisconsin, Madison, 1895.

In this drainage the several rivers share as follows:

| | Per cent. |
|---|---|
| Chippewa river (with Red Cedar at 6.2%) | 28.4 |
| Wisconsin river | 21.0 |
| St. Croix river | 13.7 |
| Wolf river | 7.4 |
| Black river | 6.8 |
| Menominee river (Wisconsin side) | 5.7 |
| Oconto river | 3.4 |
| Peshtigo river | 3.2 |
| Small rivers to Lake Superior | 9.3 |
| Small rivers direct to Green Bay | 0.9 |

Besides furnishing ample drainage, the basins of the Chippewa, Wisconsin, St. Croix, and Black rivers, which drain 70 per cent. of the entire area, are covered with the most perfect network imaginable of small streams especially suited for purposes of driving timber. The rivers emptying into Green Bay also "drive" quite well, but have required more improvements, while those running into Lake Superior are in great part unfit for driving.

*Ownership.*—Of the 18.5 million acres of land contained in this north half of Wisconsin a little less than 7 per cent. is improved; 24 per cent. is held by actual settlers, the greater part of which falls to the counties along the southern and southwestern edge of this district; the United States hold about 5 per cent. (2 per cent. being Indian Reservations), the State holds less than 2 per cent., the railways little over 5 per cent., the counties about 1.5 per cent. in tax deeds, and about five times this amount conditionally on tax certificates. Of the 63 per cent. owned by private non-residents, fully 80 per cent. is held by lumbermen. This amounts to 50 per cent. of the total area under consideration or 25 per cent. of the land of the entire State.

## TABLE I.—*Relations of ownership.*

| COUNTY. | Population by 1,000. | Taxable wealth $1,000,000. | Total area (Division Forestry), 1,000 acres. | LAND SURFACE. |  |  | Area in farms. Total improved. 1,000 acres. |  | LANDS HELD BY |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  | Division of forestry, 1,000 acres. | Land office report, 1896 1,000 acres. | Chief geographer census, 1890. |  |  | U. S. Governm't 1,000 acres. | State, 1,000 acres. | Railways, 1,000 acres. |
| Ashland | 17.2 | 5.9 | 679[7] | 676[8] | 678 | 1,054[2] | 59 | 8 | 122* | 6.7 | 122 |
| Barron | 20.1 | 1.9 | 576 | 561 | 560 | 576 | 264 | 79 | 1 | 0.3 | ........... |
| Bayfield | 12.5 | 5.0 | 977 | 955 | 959 | 899 | 51 | 2 | 74* | 6.0 | 33 |
| Burnett | 5.8 | 0.6 | 571 | 537 | 560 | 570 | 235 | 20 | 116 | 30.4 | ........... |
| Chippewa | 28.7 | 7.8 | 1,267 | 1,253 | 1,254 | 1,267 | 281 | 131 | 6 | 8.1 | 2 |
| Clark | 21.3 | 4.3 | 783 | 778 | 778 | 783 | 228 | 82 | 1 | 1.8 | ........... |
| Douglas | 29.9 | 16.5 | 858 | 848 | 844 | 855 | 25 | 3 | 63 | 8.2 | ........... |
| Dunn | 25.0 | 4.0 | 552 | 550 | 542 | 550 | 378 | 175 | 2 | ........... | ........... |
| Florence | 2.8 | 1.0 | 319 | 312 | 304 | 318 | 18 | 2 | 4 | 4.7 | 40 |
| Forest | 1.2 | 1.6 | 706 | 681 | 893[8][1] | 816[1] | 44 | 1 | 15 | 39.0 | 225 |
| Iron | 5.3 | 2.3 | 519 | 504 | 506 | [9] | 4 | 2 | 18* | 9.2 | 122 |
| Jackson | 16.7 | 2.2 | 634 | 636 | 633 | 634 | 289 | 124 | 9 | 5.8 | ........... |
| Langlade | 11.0 | 1.2 | 560 | 555 | 571 | 560 | 82 | 20 | 2 | 11.0 | 60 |
| Lincoln | 14.7 | 3.2 | 576 | 572 | 581 | 448 | 49 | 9 | 11 | 19.4 | 37 |
| Marathon | 36.5 | 5.3 | 1,013 | 1,007 | 1,005 | 1,018 | 380 | 103 | 1 | 4.2 | 5 |
| Marinette | 27 2 | 5.6 | 909 | 898 | 883 | 715 | 222 | 29 | 24 | 14.7 | 4 |
| Oconto | 18.3 | 2.7 | 723 | 713 | 702 | 721 | 187 | 58 | 72* | 8.0 | 37 |
| Oneida | 7.0 | 2.9 | 744 | 694 | 570[1] | 1,303[3] | 23 | 1 | 36 | 37.6 | 24 |
| Polk | 16.1 | 2.5 | 615 | 595 | 597 | 611 | 282 | 83 | 7 | 8.0 | ........... |
| Portage | 28.5 | 3.3 | 529 | 523 | 514 | 506 | 340 | 142 | 0 5 | 5.8 | ........... |
| Price | 7.2 | 1.1 | 827 | 815 | 820 | 742 | 97 | 7 | 12 | 29.4 | 159 |
| Sawyer | 8.7 | 1.5 | 876 | 836 | 870 | 875 | 72 | 8 | 16 | 11.8 | ........... |
| Shawano | 22.5 | 3.3 | 740 | 737 | 733 | 737 | 283 | 94 | 103* | 2.8 | 15 |
| Taylor | 8.4 | 1.0 | 692 | 682 | 621 | 633 | 72 | 15 | 8 | 0.2 | 78 |
| Vilas | 3.8 | 1.1 | 677 | 566 | 561[1] | [10] | 2 | ........... | 70* | 4.9 | 4 |
| Washburn | 4.2 | 0.7 | 552 | 529 | 545 | 552 | 87 | 5 | 62 | 9.1 | ........... |
| Wood | 21.6 | 2.7 | 529 | 515 | 514 | 529 | 184 | 58 | 0.8 | 0.6 | ........... |
| Total | 434.4 | 92.1 | 18,956 | 18,482 | 18,594 | 18,267 | 4,400 | 1,260 | 861* | 282.[5] | 957[6] |
| Total for entire state. | 1,937.5 | 603.4 | ........... | ........... | 35,275 | 34,848 | 18,400 | 9,500 | 909 | 293 | ........... |

---

* Largely Indian reservation, which make over 40 per cent. of the total. [1] Includes the part of R. 11 E., now given to Oneida, and Vilas, so that these two should be smaller by that amoumt. [2] Includes what is now Iron county. [3] Includes Vilas county. [4] The state census gives 239,000 acres; the U. S. census of 1890 gives for Ashland and Iron, together, only 23,000, so that this seems a typographical error. [5] Besides this there are 47,000 acres of park land in Iron and Vilas, which is now being sold. [6] These are chiefly Wisconsin Central and Chicago and Northwestern Railway lands. Considerable acreage is owned also by the "Omaha" R. R. and others, but details could not be obtained. [7] Figures of total areas, including water surfaces, seem never to have been published. The figures here given were obtained by the use of the town plats, allowing 23,040 acres for each township except those with irregular outlines or bordering on correction lines, for which the geometrical area of the land survey was used. [8] It being apparent that the two sets of figures given by the general land office and the census did not only not agree but bore signs of clerical or other errors (especially the census figures) a careful revision was made by use of the town plats resulting in the figures given in column 4. [9] Included in Ashland. [10] Included in Oneida.

### TABLE II.—*Surface features.*[1]

| COUNTY. | Total land surface. | Lakes and larger streams. | Cultivated land (state census report, 1895). | Forest and waste land. | Well stocked forest.[2] | Swamp, i. e., land with cedar tamarack, etc. | Cutover land waste and also "openings." | Land best left to woods. | LAND WITH A SOIL CHIEFLY OF: |  |  |  | FARM LAND.[4] |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |  |  | Clay.[3] | Loam. | Sandy loam. | Loamy sand and (poor) sand. | Good. | Medium. | Poor, i. e., forest soils. |
|  | *Thousand Acres.* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Ashland | 676 | 5 | 8 | 668 | 400 | 70 | 200 | 200 | 170 | 440 | 70 | ........ | 135 | 340 | 200 |
| Barron | 561 | 17 | 79 | 482 | 70 | 25 | 385 | 145 | ........ | 225 | 250 | 85 | 180 | 240 | 140 |
| Bayfield | 959 | 22 | 2 | 957 | 475 | 100 | 380 | 500 | 190 | 290 | ........ | 380 | 100 | 360 | 500 |
| Burnett | 537 | 34 | 20 | 517 | 100 | 80 | 330 | 315 | ........ | 110 | 110 | 320 | 55 | 135 | 345 |
| Chippewa | 1,253 | 13 | 131 | 1,122 | 500 | 60 | 560 | 390 | 125 | 865 | ........ | 250 | 310 | 560 | 850 |
| Clark | 773 | 5 | 82 | 696 | 200 | 40 | 455 | 200 | ........ | 620 | ........ | 160 | 310 | 270 | 200 |
| Douglas | 848 | 15 | 4 | 844 | 450 | 130 | 265 | 300 | 220 | 430 | ........ | 190 | 175 | 370 | 300 |
| Dunn | 550 | 4 | 176 | 374 | 75 | 10 | 290 | 140 | 110 | 165 | 100 | 175 | 160 | 250 | 140 |
| Florence | 312 | 10 | 2 | 310 | 160 | 50 | 100 | 100 | ........ | 110 | 110 | 90 | 50 | 150 | 100 |
| Forest | 681 | 25 | 1 | 680 | 400 | 140 | 140 | 270 | ........ | 370 | 210 | 100 | 140 | 270 | 270 |
| Iron | 504 | 15 | 2 | 502 | 250 | 100 | 150 | 200 | 100 | 275 | ........ | 130 | 100 | 200 | 200 |
| Jackson | 636 | ........ | 124 | 512 | 25 | 65 | 420 | 250 | ........ | 65 | 250 | 320 | 120 | 260 | 255 |
| Langlade | 555 | 5 | 20 | 535 | 350 | 70 | 115 | 150 | 165 | 270 | 80 | 40 | 165 | 230 | 160 |
| Lincoln | 572 | 10 | 9 | 563 | 345 | 50 | 165 | 145 | 120 | 350 | ........ | 100 | 170 | 255 | 145 |
| Marathon | 1,007 | 6 | 104 | 903 | 500 | 30 | 370 | 100 | 200 | 700 | ........ | 105 | 300 | 600 | 100 |
| Marinette | 898 | 10 | 29 | 869 | 300 | 110 | 460 | 450 | ........ | 225½ | 200 | 470 | 135 | 315 | 450 |
| Oconto | 713 | 10 | 58 | 655 | 180 | 85 | 390 | 215 | ........ | 360 | 210 | 140 | 140 | 360 | 215 |
| Oneida | 694 | 60 | 2 | 692 | 150 | 150 | 390 | 450 | ........ | 75 | ........ | 520 | 70 | 200 | 420 |
| Polk | 595 | 20 | 83 | 512 | 150 | 20 | 340 | 150 | ........ | 180 | 360 | 55 | 150 | 300 | 145 |
| Portage | 523 | 6 | 142 | 381 | 20 | 100 | 255 | 210 | ........ | 160 | 160 | 200 | 100 | 220 | 215 |
| Price | 815 | 12 | 8 | 807 | 380 | 125 | 300 | 325 | ........ | 365 | 250 | 200 | 160 | 330 | 325 |
| Sawyer | 836 | 40 | 3 | 832 | 525 | 130 | 175 | 350 | ........ | 415 | 340 | 80 | 165 | 320 | 350 |
| Shawano | 737 | 8 | 94 | 643 | 225 | 100 | 320 | 220 | 73 | 440 | 110 | 110 | 220 | 300 | 215 |
| Taylor | 632 | 6 | 15 | 617 | 400 | 20 | 215 | 125 | 125 | 445 | 60 | ........ | 250 | 260 | 120 |
| Vilas | 566 | 110 | 1 | 565 | 200 | 135 | 230 | 400 | ........ | 110 | ........ | 455 | 55 | 110 | 400 |
| Washburn | 529 | 23 | 5 | 524 | 100 | 50 | 360 | 265 | ........ | 200 | 130 | 200 | 80 | 185 | 265 |
| Wood | 515 | 15 | 53 | 462 | 65 | 110 | 285 | 160 | ........ | 260 | 100 | 155 | 160 | 100 | 155 |
| Total | 18,482 | 506 | 1,257 | 17,225 | 6,600 | 2,100 | 8,500 | 6,850 | 1,800 | 8,600 | 2,900 | 5,150 | 4,100 | 7,400 | 6,800 |
| Pr ct. of total. | 100 | 2.7 | 6.7 | 93.2 | 35.8 | 11.7 | 45.6 | 37.2 | 9.8 | 46.6 | 15.8 | 27.8 | 22.5 | 40.3 | 37.2 |

---

[1] In the estimates, all figures are rounded off for convenience sake.

[2] This only in part truly virgin forest since pine has been culled out in all parts of the territory.

[3] Swamps are not considered, for instance, those of the sandy areas are simply included in this and they appear as having a sandy soil, which is but partly true.

[4] This classification, when submitted to revision by the best informants, was generally accepted and their corrections usually affect the "good" farm land, while the third-class, most important in this connection, was generally considered a fair estimate.

## TABLE III.—*Standing timber in million feet board measure.*

| COUNTIES. | Total merchantable pine, white and Norway. | White pine, only saw timber. | Norway pine, only saw timber. | Hemlock, tie size and better. | Cedar down to 3 inch diameter.[1] | Tamarack, tie size and better. | Spruce, including pulp wood.[2] | Balsam, including pulp wood.[2] | Jack pine to 4 inch diameter. | Total for hardwoods. | *Million feet of saw timber.* Oak. | Basswood. | Birch. | Elm. | Ash. | Maple. | Hardwood and hemlock cordwood million cords.[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ashland | 300 | 255 | 45 | 700 | 80 | 80 | 50 | 20 | ........ | 900 | 20 | 300 | 300 | 130 | 30 | 120 | 8 |
| Barron | 150 | 145 | 5 | ........ | ........ | ........ | ........ | ........ | 50 | 50 | 50 | 60 | 50 | 40 | 10 | 40 | 1.5 |
| Bayfield | 3,000 | 2,500 | 500 | 400 | 70 | 150 | 75 | 25 | 400 | 450 | 20 | 100 | 175 | 45 | 20 | 90 | 3. |
| Burnett | 200 | 150 | 50 | ........ | ........ | 20 | ........ | ........ | 500 | 200 | 60 | 45 | 20 | 30 | 10 | 45 | 1. |
| Chippewa | 500 | 500 | ........ | 800 | 10 | 30 | 20 | 20 | 150 | 1,100 | 120 | 340 | 280 | 180 | 60 | 130 | 4.5 |
| Clark | 200 | 200 | ........ | 30 | ........ | 25 | ........ | 5 | ........ | 650 | 150 | 180 | 30 | 160 | 30 | 100 | 3. |
| Douglas | 3,500 | 3,000 | 500 | ........ | 20 | 150 | 50 | 30 | 300 | 700 | 100 | 200 | 250 | 50 | 30 | 70 | 3. |
| Dunn | 20 | 20 | ........ | ........ | ........ | ........ | ........ | ........ | 100 | 400 | 100 | 120 | 15 | 60 | 30 | 75 | 1. |
| Florence | 150 | 135 | 15 | 300 | 65 | 45 | 25 | 15 | 25 | 400 | 5 | 125 | 100 | 50 | 20 | 100 | 1.5 |
| Forest | 500 | 450 | 50 | 600 | 155 | 100 | 65 | 40 | 100 | 1,000 | 20 | 280 | 300 | 175 | 75 | 150 | 3. |
| Iron | 400 | 350 | 50 | 350 | 110 | 75 | 85 | 15 | 25 | 350 | 5 | 100 | 125 | 35 | 15 | 70 | 2. |
| Jackson | 100 | 100 | ........ | ........ | ........ | 10 | ........ | ........ | 100 | 50 | 10 | 15 | ........ | 5 | 2 | 18 | 0.5 |
| Langlade | 150 | 145 | 5 | 1,000 | 100 | 130 | 35 | 30 | 20 | 1,100 | 40 | 300 | 300 | 250 | 80 | 130 | 3.5 |
| Lincoln | 250 | 230 | 20 | 1,000 | 100 | 125 | 25 | 25 | 50 | 1,000 | 30 | 300 | 350 | 170 | 50 | 100 | 3.5 |
| Morathon | 200 | 195 | 5 | 1,500 | 10 | 15 | 5 | 25 | 10 | 1,500 | 75 | 450 | 450 | 300 | 75 | 150 | 5. |
| Marinette | 1,500 | 1,200 | 300 | 240 | 150 | 100 | 50 | 10 | 400 | 250 | 10 | 50 | 65 | 40 | 15 | 70 | 1. |
| Oconto | 75 | 65 | 10 | 500 | 75 | 35 | 15 | 15 | 50 | 400 | 10 | 100 | 120 | 50 | 40 | 80 | 2. |
| Oneida | 1,200 | 1,000 | 200 | 20 | 30 | 100 | 20 | 10 | 300 | 60 | 2 | 25 | 15 | 5 | 3 | 10 | 0.5 |
| Polk | 240 | 230 | 10 | ........ | ........ | ........ | ........ | ........ | 100 | 600 | 150 | 160 | 40 | 120 | 30 | 100 | 2. |
| Portage | 20 | 20 | ........ | 50 | 10 | 35 | 5 | 5 | 150 | 100 | 10 | 35 | 20 | 15 | 5 | 15 | 1. |
| Price | 200 | 200 | ........ | 1,000 | 25 | 75 | 20 | 15 | 25 | 900 | 30 | 300 | 270 | 130 | 50 | 100 | 4. |
| Sawyer | 2,000 | 1,700 | 300 | 900 | 45 | 125 | 25 | 25 | 100 | 1,000 | 100 | 300 | 300 | 150 | 30 | 100 | 5. |
| Shawano | 300 | 275 | 25 | 650 | 85 | 30 | 15 | 20 | 20 | 700 | 80 | 180 | 100 | 175 | 40 | 175 | 2.5 |
| Taylor | 200 | 200 | ........ | 1,500 | 10 | 75 | 5 | 30 | ........ | 1,000 | 50 | 300 | 340 | 150 | 40 | 120 | 4. |
| Vilas | 1,500 | 1,300 | 200 | 120 | 75 | 100 | 30 | 10 | 200 | 150 | 5 | 40 | 55 | 15 | 5 | 30 | 1. |
| Washburn | 350 | 325 | 25 | ........ | ........ | 40 | ........ | ........ | 250 | 220 | 40 | 60 | 40 | 30 | 10 | 40 | 0.5 |
| Wood | 100 | 98 | 2 | 40 | 10 | 30 | 5 | 5 | 50 | 300 | 75 | 75 | 30 | 30 | 30 | 60 | 2. |
| Eau Claire | 50 | 50 | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ |
| Pierce & St. Croix | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | ........ | 300 | 70 | 90 | 10 | 45 | 25 | 60 | 1. |
| Totals | 17,355 | 15,038 | 2,317 | 11,700 | 1,295 | 1,650 | 575 | 395 | 3,475 | 16,080 | 1,387 | 4,680 | 4,150 | 2,645 | 880 | 2,338 | 65.5 |
| In per cent. of hardwoods | | | | | | | | | | 100 | 8.7 | 29.0 | 25.6 | 16.7 | 5.5 | 14.5 | ....... |

[1] Ties, posts, poles, and piling are here converted into board measure.

[3] Two cords = 1 M. ft. B. M.

[2] This is estimated on the assumption that when the saw logs are removed, there are still 10 cords of firewood or material over 3 inches diameter per acre, and where large areas of culled woods exist, these also enter into consideration of this item.

## FOREST CONDITIONS OF THE PAST.

An uninterrupted forest, extending from Michigan through Wisconsin into Minnesota, originally covered almost the entire surface of these 27 counties. Along the southern and southwestern border, this forest faded into oak and jack pine "openings" and in places gave way to regular prairies. It was generally a mixed forest of white pine and hardwoods on all loam and clay lands; it approached to the regular pinery on the tracts of sandy loam and the red clays of Lake Superior, and on all sandy and loamy sand districts, it was invariably pinery proper, generally a mixture of white and red (Norway) pines. This great forest changed in character along a line extending approximately through Range 7 W. from Lake Superior to Town 31 N., from here to the southwest corner of Marathon county and thence east to Green Bay.* To the east and north of this line the hemlock joined the hardwoods and pine on all gravelly clay and loam lands; the birch (not white birch) disputed precedence among hardwoods, so that we may designate the forest as birch forest with admixtures; the red oaks were thinly scattered and the white oaks practically wanting. To the south and west of this line, the hemlock generally did not grow at all, the birch became scattering, white oaks were abundant, and the oaks gave character to the hardwood mixture, making the bodies of pure hardwoods distinctly oak forests. These bodies of hardwood were much more common on this side of the line.

Along the edge of the forest to the south and west the dense cover of a variety of tall hardwoods and conifers gave way rather suddenly to monotonous brushwoods, composed of scattered, bushy oaks, either alone or mixed with jack pine. (Portage, Dunn, St. Croix, Polk counties.)

In almost all parts of the mixed forest of the loam lands, the hardwoods formed the body of the forest and the conifers the admixture. The hardwoods were represented by trees of all sizes, from the seedling or sprout to the mature timber tree. They formed nearly all of the undergrowth and this hardwood forest showed every indication of thrift and permanence. The white pine (red or Norway pine did not grow on these loam lands) and hemlock were represented almost entirely by mature, old timber, standing isolated among the hardwoods, or at most growing in groups or small bodies. Saplings, bushy young trees, and seedlings, were comparatively scarce. Active reproduction was evidently not going on, and there is every reason to believe that both pine and hemlock were losers in a long-fought struggle for possession of the ground, in which a change in the general conditions of moisture probably had something to do with their defeat. As regards white pine this was most conspicuous in the southern counties and on the heaviest soils (Marathon, Langlade, and Dunn counties), where in many places the hardwoods had succeeded in crowding out the pine entirely, but wherever sand or gravel discouraged the hardwoods (Wood, Barron, Price and Sawyer counties), the pine held more nearly its own, and formed a fair proportion of the sapling timber.

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* The lines of distribution as here laid down refer only to the occurrence of trees as timber of economic importance, and not to their botanical distribution.

The thinly scattered balsam and the less frequent spruce appear to be in the same position as the pine and hemlock, but they were much less important trees and naturally their sparseness was less conspicuous.

In the regular pinery of the sandy soils the pines predominated, the hemlock was entirely wanting and the hardwoods were scantily represented by small white birch, aspen, and maple, which were mixed with the young pine. In the dense stands of mature timber these deciduous trees were killed out but reappeared where the superannuated pines were dying off and the cover of their shading crowns was broken. (Oneida, Vilas, Marinette, and Bayfield counties.)

On the better loamy sands the pine forest was a mixture of white and red (Norway) pine, with occasional patches (perhaps temporary) of jack pine (Vilas, Oneida counties) but on the poorer sands the red (Norway) and jack pine often stood alone as a pure growth. Either one or both together formed forests of considerable extent, usually with hardly any undergrowth and mixture save some scattering scrub oak. (Barrens of Bayfield county and in Douglas, Marinette, and Portage counties.)

The greater part of the swamps in North Wisconsin were well stocked with dense thickets of tamarack, cedar (arborvitæ), and some scattering spruce. The cedar (arborvitæ) prevailed in those of the eastern part, especially the swamps of the sandy loam lands along and near Green Bay, the tamarack had undisputed possession of those of the southern and southwestern part and also covered part of the swamps of the openings. The swamps of the central, northern, and northwestern part were stocked without regularity, some with tamarack, others with cedar, and in many of them both trees occurred together. The spruce as a very runty shrub or half tree covered many open bogs and otherwise occurred scattered in the swamps, especially within the moister hemlock area.

## FOREST CONDITIONS OF THE PRESENT.

At present these forests are materially changed. More than one million acres have been cleared and put in cultivation. During forty years of lumbering nearly the entire territory has been logged over. The pine has disappeared from most of the mixed forests and the greater portion of pineries proper has been cut.

There is to-day hardly a township in this large area where no logging has been done. In addition to this, the fires, following all logging operations or starting on new clearings of the settler, have done much to change these woods. Nearly half this territory has been burned over at least once: about 3 million acres are without any forest cover whatever, and several million acres more are but partly covered by the dead and dying remnants of the former forest.

In the better hardwood areas (Taylor, Marathon, Langlade counties) the least change has occurred; the former existence of the pine is scarcely noticed and the forest is damaged by fire only where it borders on "pine slashings" or spots where quite a body of pine occurred and has been removed. On the lighter, gravelly loam and sandy loam soils, where the pine formed a heavier admixture, the remaining hemlock and hardwoods are badly damaged and often entirely killed over extensive tracts. (Parts of Price, Chippewa, Sawyer, Washburn counties.) In most of the pinery areas proper, the repeated fires have largely cleared the lands of all the heavier debris in slashings. (Oneida, Marinette, Washburn counties, near Lake Superior at Ashland and Bayfield and in Douglas counties.) Here are large tracts of bare wastes, "stump prairies," where the ground is sparsely covered with weeds and grass, sweet fern, and a few scattering runty bushes of scrub oak, aspen, and white birch. These alternate with thickets of small pine (often jack pine) which in spite of repeated fires have escaped destruction or have re-established themselves. Nor have these changes beeen restricted to the upland forests. The swamps, too, of every county have suffered from fires. Some of the worst forest fires have started in the dense tamarack and cedar swamps of the sandy areas, where the most complete destruction has taken place. (Oneida, Price, Chippewa, Marinette counties.)

In the accompanying map an attempt is made to show the present forest conditions as well as to give some notion of the former extent and character of these woods. The areas of pinery proper, distinguished by red color, represent the pine forests of almost pure growth, without merchantable hardwoods and hemlock, covering the sandy districts of this region. The island tracts of mixed forest on heavier soil are not shown and in the same way the numerous small tracts of regular pinery scattered through the great body of mixed forest, particularly along the rivers, were left out for sake of clearness and partly because their exact limits were not ascertained. The hardwood mixed forest, distinguished by green color in three shades, to indicate differences of density or yield, is divided by a red line into two parts, the hemlock and birch area on the north and east of this line and the oak woods west and south.

The existence of pine is indicated by red signs, the plus sign

(+) being used where it still exists in considerable quantities, the minus sign (—) where it has been cut out.

Where pine predominates, the signs of the red circle with and without a cross, denoting present and former conditions are employed.

Where the hardwoods are largely cut, culled, or destroyed by fire, the minus sign in black is used, while jack pine and jack oak are in all cases indicated, the one by red and the other by green V sign.

### CONIFEROUS SUPPLIES.

The conifers, particularly the pines, formed solid, almost pure, forests over more than 30 per cent. of the area under consideration besides hundreds of groves of smaller extent scattered throughout the entire area of mixed forest. In addition, they formed the most conspicuous part of these mixed forests themselves so that the name of "pinery" was applied to the entire forest once covering this area. The conifers covered especially the poorest land, stocked the barrens, the light sands, the roughest gravel lands, and clothed the swamps wherever these permitted of any tree growth. Besides forming the bulk of the forest growth, the chief conifers, white and red (Norway) pine and hemlock grew to larger size and better shape than the hardwoods; they yielded more material and were easier logged, transported, and sawed, and their product found a much more extensive market. In total amount of saw timber the conifers originally excelled the hardwoods about as five to one, but at present all the conifers combined furnish only about twice as much material as the hardwoods.

### WHITE PINE.

*Past.*—The white pine occurred in nearly all parts of this area; in most counties it was found in every township, on almost every section, and though checked at the "openings," apparently by a lack of moisture, it followed all the streams (the Wisconsin, Black, Chippewa, St. Croix, etc.), for a considerable distance beyond the limits of the forest. Generally it seems quite independent of the quality of the soil; it grew as fast, as steadily and to as large proportions on the sandy and gravelly lands along the Flambeau, Chippewa, and Wisconsin as on the heavier soils of the divides and the famous Wolf river basin.

The yields varied with the size and number of trees per acre. It is naturally largest in mature stands of pure growth, such as may be seen in parts of Oneida and Vilas counties, where as much as 2 million feet are cut from 40 acres and where single acres might be selected cutting 100 M. feet B. M. The yield is smaller in very old timber, even in the pinery, where the stand is broken, and still more so in the old and scattered timber of the mixed forest where often but one or two trees were found to the acre. A cut of one million feet per 40 acres, or 25 M. feet per acre was and is considered a very good yield and generally the cut is less than half this amount. Since in all these wild woods the ground is irregularly covered and almost every 40-acre tract has its bare places without merchantable timber, all figures of yield per unit are somewhat misleading. Entire townships (23,000 acres) are known to have cut over 400 million feet per town while 200 million per town have been accounted for in the output of the several mills for the entire area of Wood county, and a cut of about 125 millions per town is recorded for the Wolf river above Shawano. For comparison with present supplies an attempt is made in the following table to estimate the original stand of pine for the several river basins. The figures are by no means high, and have been verified at least, for portions of every basin as explained further on.

### *Original stand of pine in north Wisconsin.*

(Only the 27 counties visited are involved here.)

| Name of river basin. | Number of township stocked. | Yield per township. Million ft. | Yield per river basin. Million ft. | Yield for river as per cent. of total per cent. | Present stand. Million ft. | |
|---|---|---|---|---|---|---|
| Black | 40 | 225 | 9,000 | 7.0 | 250 | |
| St. Croix | 100 | 125 | 12,500 | 9.7 | 3,500 | Considerable jack pine barrens. |
| Red Cedar | 40 | 200 | 8,000 | 6.2 | 475 | |
| Chippewa | 175 | 200 | 35,000 | 27.0 | 3,500 | |
| Wisconsin | 172 | 175 | 30,100 | 23.1 | 2,800 | Much hardwood area. |
| Wolf | 60 | 125 | 7,500 | 5.8 | 475 | Much hardwood area. |
| Oconto | 28 | 125 | 3,500 | 2.7 | 150 | Much hardwood area. |
| Peshtigo | 27 | 150 | 4,050 | 3.1 | 500 | |
| Menominee | 47 | 150 | 7,050 | 5.4 | 1,500 | Only Wisconsin side. |
| Rivers to Lake Superior | 76 | 150 | 11,400 | 8.8 | 4,200 | |
| Rivers to Green Bay | 7 | 200 | 1,400 | 1.1 | .......... | |
| Total | 772 | .......... | 129,400 | 100 | 17,400 | |

Of these 129.4 billion there is approximately:

| | |
|---|---|
| Standing at present | 17.4 billion feet. |
| Cut between 1873 to 1898 | 66.0 billion feet. |
| Probable cut 1840 to 1873 | 20.0 billion feet. |
| Accounted for | 103.4 billion feet. |

Leaving about 26 billion feet as probably wasted; chiefly destroyed by fire.

*Present.*—In considering the present supplies of pine, both white and red (Norway) pine, of which fully 80 per cent. is owned by lumbermen, it must be borne in mind that in spite of many years of logging, but few townships of the better stocked regions, outside of settlements, have been logged clean, and counties like Chippewa, Clark, Marathon, and even Wood, still continue to furnish large quantities of pine logs of all sizes. It is also interesting to note in this connection, that it is not so much a lack of good logs, but the fact that of late everything is cut clean, which has reduced the average size of logs to half of what it was twenty years ago. But it is especially the fragmentary or culled condition of the forest which makes general or wholesale estimates difficult, and causes the opinions on pine supplies to vary within such wide limits. "Most men know little about what their neighbors have," and "the man whose pine supply is nearly at an end, and who finds it difficult to buy more stumpage thinks that everybody shares his trouble." These two statements, variously expressed, may be heard in many places, are readily verified in every county and fully indicate the difficulty.

The figures in the following table represent the results of a diligent and careful inquiry into the present condition of supplies. It is believed that though somewhat higher than those of the majority of estimators they are still quite conservative in the aggregate and justly apportioned among the several counties:

STANDING PINE IN NORTH WISCONSIN.

| County. | Million feet B. M. |
|---|---|
| Ashland | 350 |
| Barron | 150 |
| Bayfield | 3,000 |
| Burnett | 200 |
| Chippewa | 500 |
| Clark | 200 |
| Douglas | 3,500 |
| Dunn | 25 |
| Eau Claire* | 50 |
| Florence | 150 |
| Forest | 500 |
| Iron | 400 |
| Jackson | 100 |
| Langlade | 150 |
| Lincoln | 250 |
| Marathon | 200 |
| Marinette | 1,500 |
| Oconto† | 75 |
| Oneida | 1,200 |
| Polk | 240 |
| Portage | 20 |
| Price | 200 |
| Sawyer‡ | 2,000 |
| Shawano | 300 |
| Taylor | 200 |
| Vilas | 1,500 |
| Washburn | 350 |
| Wood | 100 |
| Total | 17,355 |

The estimates here given are not calculated but simply based upon estimates of different men well informed with regard to certain parts; they were critically examined by comparing them with those of other men, and also by comparison with results of calculations based on probable cut per 40, or per town and the area supposed to be still covered with timber. Moreover, the probability of the correctness of the various estimates was subjected to scrutiny in various ways and tested by personal inspection of the field.

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* Canvassed only for its pine.

† Probably too low, but left so in deference of good authority.

‡ Believed to be 2,500 by good authority.

Upon such basis, utilizing partial and imperfect estimates, checked and counterchecked, the attempt was made to approach as near the truth as was possible by such methods. After the writer had made up his own estimates he once more submitted the same to his informants and their divergence of opinion, wherever essential, will be found noted in the part of this report which refers to conditions in each county.

The white pine appears to seed heavily and quite regularly; the trees in all parts of North Wisconsin were laden with cones in the fall of 1897. The seedlings thrive best on sandy soils, but grow on loamy soils almost as well; the young growth forms dense thickets, grows very fast in height (1 to 2 ft. per year) as well as in thickness (often one-half inch and more) and the sapling timber cleans itself quite well of its dead branches, though not as well as red (Norway) pine. In Wisconsin, the tree is normally over 50 feet high at the age of 50 years, attains a height of over 120 feet and a diameter of over 30 inches, and continues its growth in thickness with a most remarkable steadiness to a great age, 200 years and more. White pine as a mature timber has more faults than red (Norway) pine, bears more large dead stubs, disfiguring its trunk, is prone to fork, three and even four large forks often springing from the same stem, and is much more unsound, old timber being frequently defective by decay. Both white and Norway pine find a ready market in every locality, and are sold as stumpage, logs, and lumber. Fully 90 per cent. of the present cut of over 2 billion feet (about 3.5 billion in 1893) is logged on a large scale with heavy equipment and is sawn in large mills. All cutting is extremely close; in most camps everything is taken "that will make a 2x4," so that even sapling thickets are no longer spared, and the milling, driving, grading, etc., are done with remarkable care and economy. Ordinary mature timber yields about 4 to 4 1-2 logs per tree, where 5 to 7 logs cut 1 thousand feet B. M. The general average diameter of the pine logs is at present only about 14 inches and it takes 10 logs to make 1000 feet B. M. Where much red (Norway) pine is cut, the size is even smaller; large quantities are logged today where 15 to 20 logs are required to make 1 M. ft. B. M.

*Future.*—The future of pine supplies necessarily depends on the amount of growing timber and its chance to grow. Throughout the hardwood districts there is no young growth of pine of any consequence. Some groves of young pine occur on many old and burned over slashings on the sandy loam and loamy sand districts, where settlement has put a stop to the fires. In all pineries proper many thickets of young pine occur which have sprung up during the last 25 years, but most of these are on land either never logged before or else but lightly culled. If protected, these groves could soon furnish a considerable quantity of merchantable timber, but under present conditions most of them will be crippled or entirely killed by fires or else cut into cord wood for shook purposes. By far the best example of thrifty young white pine on old burned over slashings may be seen at Shawano; other fine groves occur abundantly near Grand Rapids, and other places on the Wisconsin river and also on the Chippewa and its tributaries. These groves of pine have sprung up so gradually that in many cases persons familiar with the place are astonished when the young pine are pointed out to them. After the first fires the land is covered by fireweed and aspen, then it is usually burned over a few times more, until the bulk of the débris is consumed, when the aspen is given a chance to form thickets of greater denseness. The common notion is that this is the end, that the land is now to continue in aspen and that aspen is the alternate in a "natural rotation" of pine and hardwoods. If, however, there are any survivors of pine near by—a common case, especially on slashings of former years—young pine seedlings will soon make their appearance among the aspen. But these pines require about five years before they are a foot high and so, even though numbering 500-600 per acre, they escape for years the notice of most people. Before long, however, the gray of the aspen thicket changes to a mixture of gray and green, and in a few more years the aspen grove is transformed into a pine thicket with the aspens feebly struggling or dying out. There are many of these groves of young pine in every county visited; their aggregate area is safely estimated at about 200,000 acres, and they are able to furnish within 50 years' time, if protected, a yield of more than a billion feet of marketable material. But while the ability of white pine to reproduce itself is thus amply demonstrated in every county in North Wisconsin, the fact still remains, that the great body of cut-over pine lands have not and do not at present recover themselves with young pine, but that more than 80 per cent. of the bare, burned, cut-over lands are practically devoid of any valuable forest growth whatever.

### RED (NORWAY) PINE.

The red or Norway pine occurs in every one of the 27 counties here under consideration, but is abundant only in those which contain sandy districts of greater extent. This pine does not occur on the loam and clay soils, except on the slopes along Lake Superior. It generally grows mixed with white pine on the loamy sands (Oneida, Vilas counties, etc.), and, alone or mixed with jack pine, occupies the poorer sands, as the barrens of Bayfield, Marinette counties, etc. The red pine grows quite rapidly when young and up to the age of about 100 years, growing as fast or faster than white pine on the same poor soils. It grows very slowly when old, generally forms a more slender stem than white pine, and does not attain the same dimensions, especially in its diameter. It seeds heavily and reproduces well; it shares in covering pine slashings, forms dense stands, cleans itself well of limbs, makes a straight, clean stem, is more sound than white pine, and yields very heavily. Originally it formed but a very small part of the entire stand of pine, but today about

13 per cent. of the remaining supply is red pine. It is treated like white pine in all branches of exploitation but brings a smaller price and is more extensively cut into dimension stuff. Its frugality, rapid growth, fine dimensions, and heavy yield highly recommend this tree in considerations of reforestation.

## JACK PINE.

Jack pine, in Wisconsin, generally takes possession of all the poorer sands, where hardwoods and even white pine no longer thrive. Nevertheless, it is also found on sandy loam areas (Shawano and parts of Marinette counties) where better trees have grown, and it appears that its presence in these localities is due to large fires which many years ago completely consumed the former forest and so reduced the fertility of the soil that none but this most frugal of conifers could reclothe the land. Jack pine forms characteristic dense thickets and even forests of many miles in extent, mixes frequently with red pine, less frequently with white pine and still less often with hardwoods except the scarlet and other scrub oaks and to a less extent the white birch, which are its normal companions.

In Wisconsin it is always a small tree, generally less than 10 inches in diameter and below 60 feet in height; frequently groves of several hundred acres consist apparently of trees of nearly one age and size. The tree reproduces well, grows quite rapidly, but only while young, and is generally short lived, reaching its best growth before the 80th year. At present it is not used to any extent, neither stumpage nor logs having real commercial value except in parts of the jack pine and oak openings, where it is used as fuel and for farm purposes. The total stand of this pine if taken down to 4 inches diameter is about 3,500 million feet, of which about 1,700 million might well be used for dimension stuff while the rest could be employed as pulp wood. Its great frugality, ease of propagation, rapid growth, and large yields will recommend the jack pine for the purpose of restocking all poorer sands.

## HEMLOCK.

Hemlock is confined to the gravelly loam and clay lands of the more humid half of North Wisconsin and shares some of the peculiarities of the white pine growing within these limits. It is generally old timber with little indication of active reproduction. Over wide areas only large old trees occur, and in many localities even these are gradually dying out. Wherever the forest is partly cleared, where considerable pine is removed, the hardwoods cut out, clearings and roads opened, and also where fire has run, the hemlock with its shallow system of roots at once shows its great sensitiveness to any interference in the moisture of the soil, and all or at least most of the trees succumb. In this way a large proportion of the hemlock on the lighter gravelly loams of Price, Sawyer, Chippewa, and other counties has been killed. Much of the timber on heavier lands in the vicinity of pine slashings, etc., has also died and now furnishes great quantities of dead and fallen material for future fires, which in turn will decrease the supply of the much underestimated material.

There is apparently no lack of seed, for like pine the hemlock in 1897 was full of cones, and yet there is but very little reproduction of this tree. For miles no young growth of any size is seen, and the small trees, often mistaken for saplings, generally prove to be runts,—suppressed individuals, often 150 and more years old. The only places where this tree still seems to hold its own are some of the wet "half-swamps" of the eastern part of this area. The young hemlock stands a great deal of shading and close crowding, but grows slowly both in height and thickness. The tree does not clean itself well of its branches, rarely forks, forms a more tapering trunk than the pines and does not attain their dimensions. In the southern part of its area and on the heavier soils it grows to a height of 85 to 100 feet, with a diameter of 24 to 30 inches; in the northern counties and on the lighter gravels it is usually both shorter and smaller, frequently not over 60 feet high and under 20 inches in diameter.

Hemlock is generally quite sound but much of it is claimed to be shaky at the butt. In all better localities it cuts about three logs per tree, and farther northward about two. Being generally mixed with hardwoods in very variable proportions, the yield of hemlock varies within wide limits. Mature stands of pure growth yield 500 M. feet and over per 40 acres. To cut 200 M. feet requires good hemlock land and generally where large areas are considered, and the hemlock forms 40 to 60 per cent. of the total cut (pine having been removed), yields of 100 to 150 M. feet per 40 acres may be expected. The present supply of hemlock is generally much underestimated. This is partly due to the fact that large quantities have been killed by fire and exposure to wind and sun, and partly to market conditions which prevented a proper appreciation of this product. Hemlock was ordinarily not estimated at all or only the largest and best trees were considered. According to the best informed persons, there are standing at present nearly 12,000 million feet of hemlock saw timber, an estimate which, in the opinion of the writer, is still 25 per cent. below the real truth. The distribution of this supply over the several counties is given in the general table, and whatever may be said of the total, the figures are believed fairly to represent the relative proportions. In places hemlock is extensively peeled for its bark; considerable quantities are cut into lumber, chiefly dimension stuff, and some of it is used as pulp wood. In general, however, it is not yet appreciated, so that neither stumpage nor logs can readily be sold and millions of feet are wasting in the woods. The ability of the hemlock to endure crowding and shading is more than offset by its slow growth and its demands on the soil, so that this tree deserves but a secondary place in the forest of the future.

## ARBORVITAE (CEDAR).

Arborvitæ or cedar in Wisconsin is practically limited to the moister hemlock area, but unlike this latter, continues through Douglas county into Minnesota, where it is a common tree throughout the humid forest region. Generally the cedar (arborvitæ) is limited to the swamps, but as in parts of Minnesota and Michigan, it also invades the ordinary forests. In many swamps it is wanting, frequently it is sole occupant; more commonly, however, it is mixed with tamarack, some spruce and often a few scattered hardwoods; it forms dense thickets, reproduces well, grows rather slowly, is generally under 18 inches in diameter at four feet from the ground, and is less than 60 feet in height; the older trees are normally defective at the butt. The yield of cedar is extremely variable and difficult to estimate. As it is saleable down to 4 and even 3 inches diameter the yield is generally great wherever the swamps have not been burned. A total of 1,300 million feet B. M., the equivalent of 2,600,000 cords, may be regarded as a very conservative estimate. Cedar (arborvitæ) is cut for posts, poles, both telegraph and telephone, ties, and shingle timber. Wherever it is near highways, cedar finds good market; the logging is generally done on small scale, and exact figures for the total cut are therefore not accessible.

## TAMARACK.

Tamarack, like cedar (arborvitæ) grows chiefly in the swamps; only in some of the moist and cold localities, especially along Lake Superior, does it invade to a small extent the upland woods. Unlike the arborvitæ the tamarack inhabits the swamps quite to the western and southern limits of the district under consideration, and even stocks part of the swamps of the adjoining oak and jack pine openings or brush prairies. In these drier localities it remains small, but within the more humid parts it attains commonly to 12 or 16 inches in diameter, reaching a height of 70 to 80 feet with a most remarkably small taper. It reproduces well, grows quite fast, forms very dense thickets, often entirely covering the swamp with poles of nearly one age and size, but also often occupying merely its edges or the center. It may be practically alone, i. e., form groves of pure growth, but quite often it is mixed more or less with cedar, spruce, and some hardwoods. The former condition frequently or nearly always obtains in the drier western or southern parts. Being saleable only as tie and pile timber, tamarack under 10 inches is not merchantable; and many swamps, though densely stocked, contain not a cord of marketable material. The older stands are generally more open, many of the trees having fallen prey to age and weather. These, with the tall marsh grass and the large masses of dead and fallen timber form, during dry seasons, most favorable starting points for fire. For this reason many of the swamps, in some counties the majority, contain no green timber and continue to be for years a serious menace to the surrounding country. The standing merchantable tamarack is estimated at about 1,600 millions of feet or 3,200,000 cords, to which would have to be added at least an additional 3 million cords, if pulp wood down to 4 inches is included.

In estimating the amounts of swamp timber, both cedar (arborvitæ), tamarack, and spruce, the area of the swamps is estimated in lump for some counties, but more commonly by going over the minutes and maps for each township with some well-informed person. The area of burned-over and open swamps was then deducted, and finally a yield per acre for the wooded swamp area settled upon. This latter is generally about 3 thousand feet or 6 cords per acre, and though apparently low, is not far from the truth when compared with estimates of large areas which have been examined in this connection. In the proportion of cedar (arborvitæ), tamarack, and spruce, locality and market conditions are considered. For some localities, upland cedar and spruce are also estimated.

Though many of the tamarack and cedar swamps will, in time be converted into hay marshes and even fields, both cedar and tamarack could well continue to produce large quantities of useful material. At present but little tamarack is cut. Some is sawn into dimension stuff, little of it is used for piling and poles. Strangely enough, the poor sappy poles of red (Norway) pine are preferred to it in the market, and tamarack, even for ties, has such a poor rating that most of the ties of these sections are either shipped in or made of hemlock.

## SPRUCE.

Spruce occurs scattered throughout the moister loam land districts, especially of the northern and eastern part of this territory, but is more commonly restricted to the swamp and semi-swamp areas. On many of the poor moss bogs it forms the only tree growth. It is nowhere abundant, form no solid bodies, in a mere runty shrub or half tree on the moss bog and even on the better soils attains a diameter of only about 12 inches with a height of 50 feet. Trees over 12 inches are the exception, trees 18 inches and over are rare. It seems to reproduce fairly well, endures shade but seems sensitive to changes in soil moisture, thriving only in very moist localities. Being scattered, spruce is logged only in a small way, though altogether considerable quantities are being cut for pulp and an increase of this cut may be expected.

The total stand of spruce in North Wisconsin may be placed at about 1,200,000 cords, including all wood down to 4 inches.

## BALSAM FIR.

Balsam fir is thinly scattered in most forests of the more humid loam and clay lands. Like spruce it is often wanting over considerable tracts, but few large districts are entirely without it. It reproduces well, stands crowding, and endures shade; grows fairly well when young and favorably situated, remains small, but is never as shortlived as is often supposed. It is generally less than 12 inches in diameter and below 60 feet in height. It never forms large bodies of forest, is little used as yet, rarely cut for logs, occasionally for temporary buildings, and of late, to some extent, for pulp wood. Being usually left out of timber estimates, the amount of standing balsam is not easily ascertained. In all forests where balsam fir occurs in commercial quantities the yield per acre was placed at from 2 to 4 M. feet B. M. or 4 to 8 cords per 40 acres, an estimate which agrees with some estimates made by the Chicago & Northwestern Railway company in Forest and adjoining counties. This figure will generally prove considerably below the truth, but it seems desirable to have at least some estimate, however crude, of this material, especially as it is already beginning to have a market value as pulp wood. Including everything from 4 inches up there are probably about 800,000 cords. The balsam fir has no future, the ground it occupies is largely farm land, its growth is too slow, its size too small to commend it to future operations.

## HARDWOOD SUPPLIES.

No sharp limits of distribution or composition of the great hardwood forest are possible, aside from the general outlines of the part which bears hemlock and birch as differentiated from the oak forest. Basswood, maple, elm, and ash, the principal hardwoods aside from oak and birch, all entered into the composition of the hardwood forest in nearly all parts of this area, though in widely varying proportions. Thus in one locality elm forms 30 per cent. and more of the woods, while in another, but few miles distant and with soil, drainage, etc., alike, the elm is nearly replaced by basswood or birch. Nor is it easy to draw lines with reference to size and quality of development. Good timber on good soils passes by easy stages into inferior timber on poorer soils, and it is but fair to say that some good timber grows in every county. In general it is an unquestionable and well recognized fact that the hardwood timber becomes smaller and scrubbier toward the north; and, when the extremes, as for instance the hardwoods of Dunn or of Shawano counties are compared with those of Iron and Douglas counties, this truth is quite apparent, but the transition is gradual and any apparent lines of demarcation are generally explained by differences in soil rather than effects of climate. In the southern portion of the area under consideration, the hardwoods attain considerable dimensions. Oak, basswood, and elm 90 to 100 feet high and over 30 inches thick are nothing unusual. In general, however, the mature timber is under 30 inches in diameter and under 75 feet in height, and on large tracts shorter than 60 feet and under 20 inches.

Generally the hardwoods are "short bodied" as compared to conifers; they furnish per tree about 2 1-2 logs and in the northern counties scant 1 1-2 logs, of which it takes 7 to 10 to the thousand feet B. M. Of the different kinds, basswood and elm are tallest and longest in body, the former quite commonly cutting 3 and even 3 1-2 logs per tree, and the latter often furnishing ship timbers 60 to 70 feet in length. Birch is generally the shortest, and large trees often furnish but a single log. As might be expected, much of the older hardwood timber is in all stages of degeneration and decay, so that much of it is defective and the cut consequently wasteful. The oak, being naturally the longest lived and having the most durable wood, is least affected, "it cuts sound;" basswood, birch, and ash are about alike and quite defective when old; while of all hardwoods the maple is the worst in this respect. With this tree especially, the fault is not entirely a matter of age but seems largely due to injury in consequence of frost; "frost cracks" with their peculiar rampart-like thickenings or ridges along their edge being very common. These cracks admit fungi and insects and thus introduce decay. This evil in maple is most strongly complained of in the central and northern parts and least in the southeast and southwest, where a great deal of fine maple occurs.

Concerning the yields in hardwoods, opinions differ widely; the estimates are generally too low and are commonly deficient. The reasons for this are several. Lack of experience both in estimating and milling of hardwoods is a chief cause, the men being used only to pine but not to hardwoods. To this must be added, lack of time, the work usually being too hurried, and also the fact that most of the work is done for certain kinds of timber only, oak, basswood, elm, etc. Such estimates usually include only choice material, the peculiarities of the hardwood market reacting even on the matter of estimates. Generally the yields are estimated at from 80 to 150 M. feet per 40 acres, or 2 to 4 M. feet per acre for fair to good lands, and from 25 to 50 M. feet per 40 acres for the poorer lands and the northern lake districts. Some townships in Wood and Marathon counties are known to have cut over 100 million feet per town or nearly 5 M. per acre for the total area, swamp and all. Smaller districts, as some forests in Shawano and Langlade counties, cut from 10 to 15 M. feet per acre, but these must be regarded as exceptions.

The standing hardwood and hemlock was determined by ascertaining the area of fairly stocked woodland, excluding swamp lands, then settling on the yield per acre, or 40, and finally estimating their relative proportions. The determination of the area is the weakest point in the estimates. The yields for all principal localities are based on wholesale estimates and results of actual operations. Thus the cut per township, or the cut for a number of sections, was considered, as also the estimates of lumbering and railway companies, besides the detailed experience of several hundred men, and the results weighed by comparing the growth in different localities.

The proportions of hemlock and hardwood and the different kinds of hardwoods among themselves, is also ascertained in the same manner. There exist for all principal localities, extensive detailed estimates; those of the Chicago & Northwestern Railway, and also those made for several years by Mr. Ben. Hall of Marinette, are models of this kind. Of these, a number were examined, and in addition the views of different operators compared. To most men the figures of yield will probably seem high, and in truth 6 M. feet per acre, or 240 M. per 40, does appear like a large amount even for the best counties. But it must not be forgotten that here all kinds of timber, birch, maple, elm, etc., are considered merchantable, and also that all sizes above 12 inches diameter, and for oak and hemlock even tie sizes are included. Waste and swamp areas are excluded and thus only the acres of well stocked land enter into consideration. Those who consider the yield as taken too low (and there will be many of these) will bear in mind that merchantable saw timber in hardwoods and hemlock, is at present quite a different thing from pine, and also that both hardwoods and hemlocks are short-bodied, have been injured by fire, and involve in all old stands a heavy per cent. of defective material.

*Present stand of hardwood saw timber.*

| Kind of wood. | Million ft. B. M. | Per cent of all hardwoods. | Percentage. |
|---|---|---|---|
| Oak | 1,400 | 8.6 | 75 per cent red oak. |
| Basswood | 4,600 | 29.0 | |
| Birch | 4,150 | 26.0 | Yellow or red birch. |
| Elm | 2,650 | 16.5 | 80 per cent. rock elm. |
| Ash | 900 | 5.6 | Mostly black ash. |
| Maple | 2,300 | 14.3 | |
| Total | 16,000 | ............... | |

The hardwoods are cut in all parts of this territory, they are generally logged in a small way and most of the lumber is cut in small mills, with a yearly output of 1-2 to 5 million feet. According to a masterly canvass conducted by the *Northwestern Lumberman* of Chicago, the results of which are published in its issue of January 22, 1898, the total output of hardwood lumber amounts to about 275 million feet B. M. To this must be added large quantities of mining timber used in the mines of Florence, Iron, and Ashland counties, railway ties, piling and construction, and ship timbers; and also considerable quantities of cooperage material and wagon stock, which in the aggregate probably bring up the total cut of hardwoods to about 500 million feet.

The most valued and therefore the most culled of the hardwoods is the oak, particularly white oak, the exploitation of which was begun in Wood and Clark counties more than 25 years ago. Of the other hardwoods, the basswood is most extensively cut and finds the most ready market, followed in this respect by elm, particularly the fine rock elm. Birch, though the prettiest wood of the region, is much underrated, owing to fashions which prejudice the market. Nevertheless, large quantities are cut every year and the same is true of maple, which is generally the least estimated of the hardwoods. Owing to its irregular distribution, ash is of local importance only, though in some places it is claimed that ash logs are as easily procured as almost any other. (Oconto county.)

Among trees of secondary importance aspen (poplar), white birch, butternut and beech may be mentioned in order of their economic value. The aspen (poplar), both the common aspen and large-toothed aspen are found in all parts of the area, but are conspicuous as timber trees only in the northern forests, especially of Douglas, Bayfield, and Ashland counties. These aspens (poplars) take possession of all burned slashings, but aside from their value as nurse trees to pine and better woods the aspens on the slashings of North Wisconsin have generally been of no value so far, and it appears doubtful if they ever will be except in a few localities, chiefly in the better sandy loam districts.

The white birch is best developed near Lake Superior, but never grows large, generally remaining a mere sapling, commonly less than 12 inches in diameter and 50 feet in height. In this territory it is almost always a member of mixed woods, often joining the white pine, and rarely forms thickets by itself (on some burned areas in Forest county.) It is cut for chair stock, etc., but 90 per cent. of all white birch is too small for present markets.

The butternut is sparingly scattered over the better loam lands as far north as the Iron Range. It occurs isolated, rarely in small groups, and though it grows to good size its distribution here seems uncertain and accidental.

The beech is restricted to the sandy loam lands of the Green Bay region, and invades only the edges of the real loam or clay lands of northern Oconto and Shawano counties. Wherever seen, it appears to thrive, is abundant in all sizes and evidently reproduces well.

Throughout the hardwood forests all stages from the seedling to the old and decaying timber trees are represented. In some cases the stand of old, mature timber is quite heavy, and undergrowth and sapling timber are restricted; but more generally the mature trees are in the minority, and are scattered about, standing 10 to 20 per acre, and the greater part of the ground is occupied by young trees, small saplings, and bushy or withy beginners. The undergrowth is generally composed of the young forest trees, and distinct kinds or species performing this function are few, often wanting. All kinds of hardwoods reproduce actively as is well illustrated in numerous windfalls and abandoned clearings, where dense thickets of mixed hardwoods occupy every foot of the ground. Abundance of seed and ability to stand shade enable the maple to predominate among the young growth even where it holds but third rank and less as a timber tree. Conspicuous among the young growth, without ever attaining the size of log timber, are the blue beech, bush or striped maple, and, somewhat less abundant, the hop hornbeam. As a common underbrush proper, on both loam and sandy soils, can be mentioned only the hazel. The dogwood (cornel) and wild red (pin) cherry are much less abundant; the latter becoming really conspicuous only on the burned lands. The willows are quite abundant as scattering brushwood in open places, and occur on the dry sandy soils as well as on clay lands. Alder replaces the large willows along many of the streams and in some swamps. It is never more than a bush, but as such forms characteristic alder brakes.

The scrubby hardwoods of the openings consist almost exclusively of oaks. A variety of both white and red oaks (particularly bur, white, and red oaks) grow here into bushy dwarfs, 15 to 25 feet high, 4 to 12 inches in diameter and branching out almost from their very base. These scrub oaks occasionally form thickets but generally stand too far apart to prevent a ground-cover of grass and weeds.

Since the hardwood forest occupies the better soils, its area will necessarily continue to be diminished as the country is settled, and the present supply of timber will be reduced at a rate quite independent of hardwood lumbering. Nevertheless, the difficulty of clearing the land, the comparative safety from fires, and the abundance of young, well growing stock all combine to prolong the supplies. The outlook for the hardwoods is far brighter than for the much more valuable pine.

### TOTAL SUPPLY OF TIMBER.

In the following table the entire supply of timber is arranged according to the uses that might be made of the same:

*Classification of wood supplies.*

| I. SAW TIMBER. | CONIFERS. | | |
|---|---|---|---|
| | Million feet B. M. | *As per cent. of* | |
| | | Conifers. | Total saw timber. |
| White Pine | 15,000 | 52 | 33.3 |
| Norway pine | 2,300 | 8 | 5 |
| Hemlock | 11,700 | 40 | 26 |
| Totals | 29,000 | 100 | 64.3 |

| I. SAW TIMBER. | HARDWOODS. | | |
|---|---|---|---|
| | Million feet B. M. | *As per cent. of* | |
| | | All hardwoods. | Total saw timber. |
| Oak | 1,400 | 8.6 | 3.1 |
| Basswood | 4,600 | 29.0 | 10.2 |
| Birch | 4,150 | 26.0 | 9.3 |
| Elm | 2,560 | 16.5 | 5.0 |
| Ash | 900 | 5.6 | 2.0 |
| Maple | 2,300 | 14.3 | 5.1 |
| Totals | 16,000 | 100 | 35.7 |

Total of saw timber, 4,500 million feet.

*Classification of wood supplies*—continued.

| II. Poles, Piling, Ties, Posts, Etc. | Million feet B. M. |
|---|---|
| Cedar | 1,300 |
| Tamarack (over 8 in.) | 1,600 |
| Jack pine (over 8 in.) | 1,700 |
| Total | 4,600 |

| III. Cord Wood for Pulp, Fuel, Charcoal, Etc. | 1,000 Cords. |
|---|---|
| Hemlock | 5,500 |
| Jack pine (under 8 in.) | 3,600 |
| Tamarack (under 8 in.) | 3,000 |
| Spruce | 1,100 |
| Balsam | 800 |
| Totals for conifers | 14,000 |
| All kinds of hardwood | 60,000 |

IV. Sapling Pine under 8 inches about 5 Million Cords.

It will be observed that an enormous amount of coniferous material exists which under present conditions possesses hardly a market value. Most of this material is good both for lumber and pulp and it is to be hoped and expected that its loss by fire and otherwise will be averted.

### PRESENT ACCRETION OR INCREMENT.

In North Wisconsin a grove of well grown sapling timber 60 years old, of pine, may be assumed to cut at least as much as 15 cords of bolt size material, or about 6 M. feet B. M. per acre. In the old woods as they stand, the trees above sapling size represent the great mass of the wood material and therefore the growth of wood is largely on trees nearly or quite of log size, so that the same amount of growth per acre here adds more saw timber than in the young grove above considered. For this reason, a good thicket of pine 60 years old may not cut much more than 6 M. feet per acre, since much timber is under sized, but the same stand at 120 years old would easily cut 15–20 M. in spite of the fact that over half the trees that were found in the 60 year grove have died before this age is reached. From this it would appear that 100 feet B. M. per acre and year on sapling timber is probably a safe estimate for the growth in this region. About the same conclusion will be reached if a grove of old hardwoods is considered. Such a grove, which may cut say 6 M. feet per acre, will be found to consist largely of young trees, and among these 20–30 good sized older trees. If examined, it will be found that the age of the oldest is not over 150 years, so that here about one-third or less of all the trees standing on the acre have produced in 150 years the 6 M. feet B. M., which we are taking for lumber. The whole acre, therefore, may well be assumed to be able to produce this quantity in one-third this time, or in other words the same acre might be logged over for 6 M. feet about every 50 years. Such an assumption is fully supported also by comparing the cross-sections of the pine and hardwood. These show that, though the rate of growth of hardwoods in Wisconsin is rather slow, yet the growth of oaks, basswood, etc., equals and excels that of pine.

If, then, 100 feet B. M. per acre and year be assumed as an average estimate of growth for this region, the total annual growth over the whole may be set at about 900 million feet B. M. and is distributed among the different kinds according to their ascertained acreage as follows:

| | Million feet. | | Million feet. |
|---|---|---|---|
| White and red (Norway) pine.. | 250 | Cedar......................... | 20 |
| Jack pine..................... | 30 | Spruce and balsam............ | 10 |
| Hemlock...................... | 75 | Hardwoods.................... | 500 |
| Tamarack..................... | 30 | | —— |
| | | | 915 |

Of this growth the greater part is balanced by decay or natural waste, which in all wild woods necessarily equals growth when large areas and long periods are considered. For white pine, red (Norway) and jack pine, also tamarack and cedar (arborvitæ) in Wisconsin, nearly half the present growth takes place in young, immature timber, since this largely prevails. With pine in the hardwood forest and still more with hemlock, decay proceeds faster than growth; for spruce and balsam an increase is doubtful, and with the hardwood forests in general, growth and decay seem in a condition of equilibrium. This growth is of course reduced by all operations reducing either the forest area or the growing timber; by clearing, by logging sapling or growing timber, and most of all by fires.

## COMMUNAL INTERESTS IN FOREST CONDITIONS.

### *Forest and Wealth.*

The importance of the forest to the State of Wisconsin as a factor of wealth is very great. The statement that "the wood industries have built every mile of railway and wagon road, every church and schoolhouse, and nearly every town, and that in addition they have enabled the clearing of half the improved land of North Wisconsin," is by no means extravagant exaggeration. Between 1873 and 1898 more than 66 billion feet of pine alone were cut from this forest and even then the lumber industry was in a flourishing condition on all the streams and had built up La Crosse, Eau Claire, Chippewa Falls, Grand Rapids, Wausau, Fond du Lac, Oshkosh, Green Bay, and many other places. The output of the lumber industry alone for the year 1897 is illustrated in the following table, taken from the *Northwestern Lumberman*, whose excellent canvass has before been referred to:

*Total out of lumber in Wisconsin for the year 1897 (taken from the Northwestern Lumberman, January 28, 1898.*

| Name of district. | Million Feet B. M. | | |
|---|---|---|---|
| | White and Norway pine (alone.) | Hemlock. | Hardwood. |
| "Below Minneapolis," i. e., on | | | |
| Mississippi River[1] | 284.3 | 3.8 | 7.1 |
| St. Croix Valley [2] | 105.0 | ........... | ........... |
| Chippewa Valley | 274.3 | 18.8 | 26.7 |
| "Omaha" Road (Ch., St. P., M. & O. R. R.) | 185.2 | ........... | |
| Wisconsin Valley | 398.7 | 23.6 | 60.6 |
| Wisconsin Central Road | 134.1 | 24.3 | 84.5 |
| Lake Shore (Ashland Branch) | 126.5 | 18.9 | 61.1 |
| Ashland district | 265.3 | 2.6 | ........... |
| "Soo" Line (N. St. P. & S. St. M. R. R.) | 150.2 | 2.6 | 7.1 |
| East Central Wisconsin | 86.6 | 9.9 | 6.9 |
| Southern Wisconsin | ........... | ........... | 10.3 |
| Miscellaneous | ........... | ........... | 2.7 |
| Duluth District | 34.0 | ........... | ........... |
| Green Bay Shore (a) below Menominee [3] | 129.0 | 11.9 | 6.0 |
| Green Bay Shore (b) on Menominee | 167.0 | | |
| Total | 2190.7 | 116.4 | 273.0 |

[1] Only ⅙ of the original item is supposed to be cut on Wisconsin soil.

[2] Only ⅙ of the original item is supposed to be cut on Wisconsin soil.

[3] Only ⅙ of the original item in Menominee is supposed to come from Wisconsin, but the part "below Menominee" is all credited as cut in Wisconsin.

The following table, the data for which have been taken from the annual statements of the lumber cut, as given by the *Northwestern Lumberman* represents chiefly the output of pine. Since in the original statements Wisconsin was not clearly separated from Minnesota on the one hand and Michigan on the other, it was necessary to modify some of the original figures. The "Duluth District" was entirely left out as being supplied from Minnesota although West Superior is included in this item. This latter item could be segregated and added to the data given below, only for the cut of 1897. Of the "St. Croix River" and "Green Bay shore" only one-half is credited to Wisconsin; and of the "Mississippi River" only one-third.

CUT OF LUMBER, (CHIEFLY PINE) IN WISCONSIN DURING THE 25 YEARS ENDING 1897

| Year. | Lumber cut million feet B. M. | Year. | Lumber cut million feet B. M. |
|---|---|---|---|
| 1873 | 1,240 | 1885 | 2,710 |
| 1874 | 1,200 | 1886 | 2,680 |
| 1875 | 1,250 | 1887 | 2,890 |
| 1876 | 1,340 | 1888 | 3,210 |
| 1877 | 1,000 | 1889 | 3,270 |
| 1878 | 980 | 1890 | 3,680 |
| 1879 | 1,470 | 1891 | 3,010 |
| 1880 | 1,920 | 1892 | 4,010 |
| 1881 | 2,190 | 1893 | 3,490 |
| 1882 | 2,580 | 1894 | 3,100 |
| 1883 | 2,750 | 1895 | 2,800 |
| 1884 | 2,950 | 1896 | 2,080 |
|  |  | 1897 | 2,430 |
| Total for 25 years |  |  | 60,210 |

To this must be added about 10 per cent. for shingles, lath, etc., so that the total saw mill output for the period was about 66 billion feet B. M. In this amount insignificant quantities of hardwoods and hemlock are included, while in earlier times probably a considerable amount even of pine cut is not represented, the earlier figures being less accurately ascertained.

To this enormous amount of marketable material must be added large quantities of cedar timber, ties, poles, posts, piling, etc., also ties, piling, and construction timber of hardwoods and hemlock; ship timbers, the exploitation of which has brought special crews from Quebec and other points to these woods; large quantities of cooperage and wagon stock; many million feet of mining timbers; besides many more millions of feet of material for home use, fuel, and charcoal. The value of these materials according to the State Census of 1895 exceeded in that year the enormous sum of 53 million dollars for "lumber and articles of wood" alone. This sum amounted to more than one-third the entire value of the products of agriculture. Besides these materials there were large quantities never recorded by the census and still larger amounts were used in home consumption as fuel, fencing, construction material, etc., which may safely be valued at 10 million dollars.

In 1890, according to the very incomplete federal census of that year, the value of the rough lumber, cooperage, and wagon stock, ties, poles, posts, piling, and all products of the wood industries as they leave *the first hand,* amounted to 40.4 million dollars. If to this is added the value of pulp and tanning material, of mining timber, and that of the large home consumption, it brings up the total to fully 50 million dollars for these products at first hand and shows them, like the census figures of 1895 to exceed one-third of the value of all farm products of the state. And to these farm products alone are the simple forest products comparable, for in most other industries the same article often highly finished and costly, appears with little or no modification as a product of several branches of the same industry. Thus for instance, the same piece of costly wrought metal is first credited to the rolling mill, then appears with little change as a product of the boiler maker, and reappears without change as part of a distilling outfit, or a steam engine. It thus occurs three times as a product of the iron industry, besides perhaps swelling the output credited to a shipbuilding establishment.

Besides their own value, the products of the woods stimulate secondary manufacturing industries, supply planing and pulp mills, furniture, cooperage, and wooden-ware establishments, wagon and car shops, whose aggregate output in wooden articles amounts to over 20 million dollars.

In 1890 there was invested in the saw milling industry alone, according to the census of that year, fully 84.5 million dollars, or a sum equal to one-third of the assessed value of all land in the state, or about one-sixth of the value of all real estate and over one-eighth of the assessed value of the entire wealth of Wisconsin. Of the 84 millions over 13 fall to the milling plants and machinery, 11 millions to logging equipments, logging railways, etc., including also logs on hand at the time, and over 31 millions to timberland, tributary and belonging to the saw-mills. These same establishments paid during that year nearly $700,000 taxes, a sum equal to the *total* state taxes of Wisconsin; they paid over $3,000,000 for running expenses aside from wages; about 15 million dollars for wages and logging contracts and over $700,000 for the keep of animals alone.

The lumbering industry gave employment in a regular way to over 55,000 men (not women and children), besides purchasing several million dollars worth of logs. Of those persons employed in these operations a large per cent. are settlers who through this industry alone are enabled to support themselves until their slowly growing clearings furnish sufficient harvest. It is the taxes on timber land (not waste land, however,) and its industries which furnish the "road money" and it is this same fund which builds, equips, and largely maintains in the thinly settled backwoods of Wisconsin, schools equal if not better than those of the country districts of any other state. It is this same industry which for years has made farming in the backwoods more profitable, and the farmers more prosperous than those of some other states with milder climates and equally fertile soil. Nor is it the pine alone which has done and is doing so much for this country. For owing to an unnecessary and injurious competition in the exploitation of the pineries there has resulted a concentration of milling and logging operations which in many cases deprived the particular counties in which the pine supplies were located, of much of the benefit which otherwise would have accrued to them from this resource. It is therefore to be expected that to counties like Langlade, Shawano, Forest, Lincoln, Taylor, and others, the standing hemlock and hardwoods promise to be of greater value than was their former stand of pine.

### *Forest, Climate, and Waterflow.*

It is conceded by all that the forest exerts a beneficial influence in tempering the rigors of a cold continental climate with its sudden changes and severe storms. What share the forest has in the general changes of humidity is not so apparent. It seems quite certain that a general and very gradual change from a moister to a drier condition has been going on for a long time over the entire Lake Region. The behavior of hemlock and even of white pine in the matter of distribution is probably in part due to this change. How much the forests have done to retard the progress of this desiccation can only be inferred. On the other hand there are striking changes in the drainage conditions which have required but a short time, have taken place within the memory of many of the residents, have fairly forced themselves on the attention of all experienced and observing people. These are all too intimately connected with the changes in the surface cover to leave in doubt the influence of the forest upon drainage.

The flow of all the larger rivers has changed during the last 40 years; navigation has been abandoned on the Wisconsin, logging and rafting have become more difficult on all rivers, and, what is even a far better measure of these important changes, the Fox river is failing to furnish the power which it formerly supplied in abundance. On all smaller streams similar observations have been made. The "June freshet," which in former years could be relied upon in driving operations, has ceased on most streams and is uncertain on the rest of them. Of the hundreds of miles of corduroy road a goodly per cent. has fallen into disuse, the ground on the sides has become dry enough for teams, many swamps of former years are dry, and hundreds of others have been converted into hay meadows and fields without a foot of ditching. Tamarack stood on parts of the present site of Superior, and both cedar and tamarack were mixed through the forests in many places where the mere clearing has sufficed to dry the land for the plow. Many of the smaller swamps are changed before actual clearing takes place. Where the fires following the logging operations have cleaned out the swamp thicket, aspen followed the fire exactly as in the upland, and though in some cases many years have elapsed, the places have not reverted to swamp timber. The ground is too dry, the hardwood thickets have come to stay. These things are well known, especially to the woodsmen of the region; they are in all cases referred to the removal of timber, and there is probably no locality in the world where this subject could better be studied than in North Wisconsin. A drive with some old resident through the settled parts of Shawano, Marathon, Taylor, and other counties and the rehearsal of his memories present matters of the utmost interest in this connection, and will hardly fail to convince even the most skeptical of the decided changes in drainage and soil moisture which have occurred here and are still in progress.

## THE OUTLOOK FOR THE FUTURE.

It is impossible to foretell how long the pine is likely to last. As stumpage increases in price and the opportunity to buy it decreases, one mill after another drops out. Half the mills of 20 years ago are no longer in existence, not because they failed to pay but because their pine supplies gave out, and this same process will continue. The output, already on the decline, will grow smaller, and the exploitation of the 17 billion feet of standing timber is likely to be drawn out over a period far greater than would seem possible with the present rate of cutting. Nevertheless, the experience of parts of Michigan and also of Wood, Portage, and other counties in Wisconsin indicate that cutting will go on without regard to the end, and its rate depends merely on considerations of market conditions and facilities for handling timber, so that the end of the greater part of pine lumbering is likely to be quite sudden, and its effect correspondingly severe.

The cut of hemlock, though still small, may at any time take on considerable dimensions. There are several good reasons which make this desirable. The wood is much better than is commonly assumed, and it is mere prejudice—and more the prejudice of the carpenter than of the consumer—which prefers poor pine to good hemlock. For some time the old hemlock has been dying out quite rapidly in most parts of this area; this process will certainly continue and unless the old stands are cut, much valuable material will be lost.

Hardwood lumbering will continue for a long time, though probably at a very variable rate. As things are now, the present cut of 4–500 million feet per year can be continued for more than 50 years unless settlement and consequent clearing should progress at a very unusual pace.

The outlook for the forest itself has been indicated in the preceding. The hardwood forest is being reduced by logging and clearing, the pineries are disappearing and fires assist the destruction of both besides burning out the swamps.

As pointed out, both white and red (Norway) pine are perfectly capable not only of continuing as forests but of reclothing the old slashings, but are generally prevented from doing so by fire.

The hemlock is in a process of natural degeneration and even the hardwoods, though thrifty and intact as forests, seem to fail on most cut-over lands wherever fire has run. Thus about 60 per cent. of the burned over lands are today devoid of any valuable growing timber; producing firewood at best. Another 40 per cent. of the 8 million acres of cut-over lands are entirely bare. And this unproductive area is rapidly increasing in extent under present methods.

Counting that 100 feet B. M. could be grown as the possible annual increment per acre on lands which are left entirely without care, save the protection against fire, the State of Wisconsin loses by this condition of affairs a round 800 million feet B. M. of a marketable and much needed material. This loss is primarily a communal loss, a damage to county and state, for the individual owner does not suffer; the land is bought for the timber and when this is cut the land is only held if it appears that a low tax assessment and opportunities to sell, etc., will promise more profit in holding than in abandoning it.

### FORESTRY OR AGRICULTURE.

The point is raised that this land is needed for agricultural purposes; that all of it will soon be settled since even on the poor sand lands improved methods and potato crops have proved a success. While the statement is certainly true of all good clay or loam lands, it applies but doubtfully to over half and certainly not at all to nearly 40 per cent. of this area. How long it takes to improve a territory, how much unproductive waste remains even in the older so-called "well settled" counties appears from the following concrete cases.

Of old Sauk county not one-half is improved land; the five counties of Adams, Waushara, Juneau, Marquette, and Monroe, with an aggregate area of over 2 million acres of uncommonly level land, have 30 per cent. improved land, or over one and one-half million acres of waste and brush land, most of which is not even serving the purpose of pasture. Adams, Marquette, and Waushara counties with their 800,000 acres of waste land, instead of having 80 million feet of pine to sell which might be growing every year on its non-productive area, supported in 1895 a wood industry whose product amounted to the pitiful sum of $13,000 and probably the material for this was imported.

But even where the land is good and might all be farmed it remains doubtful whether the forest can entirely be dispensed with. Experience in older countries and the Eastern States speaks against this; the farmers of the fertile prairies are planting trees for the sake of wood, on land of unexcelled fertility. Some of the farmers of Trempealeau and other counties who go 20 and more miles, invading jack pine groves for their fuel, find that wood is both too necessary to do without and too bulky to haul far; and valuable as pasture land is to the thrifty farmer of southern Wisconsin, the great importance of a convenient wood supply has led to an actual increase in wooded area in most of the southern counties of the state.

How soon the 17 million acres of wild land of North Wisconsin will be settled no one can tell; the likelihood is that over

10 million acres, and among these much of the best land, will still remain either woods or unproductive brush land in 50 years to come. What advantage it is to a county and to the state to have poor, unproductive sand lands settled by poor and ignorant people, and support farms "without barns," cannot here be discussed. In the same way, it is not here contemplated to enter into the question of communal property, i. e., whether it might not be well for a county, which can get land for the mere taking, to hold a few townships in county forests and have these county forests at least defray the county expenses, and give work to many people. If not the counties, certainly the state can afford to acquire and hold for the future all cut-over lands. Such communal properties have been mainstays of European states in all financial crises and have been eagerly sought and guarded by all European governments as well as by towns, counties, and cities. With a county holding 100,000 acres of good forest land, every citizen becomes part owner, his store or shop is valued in proportion as it shares these advantages, and instead of hindering the development of a county, as is often claimed, such a forest property would stimulate immigration and help to develop both directly and indirectly all the resources of the county.

## RECOVERY AND PREVENTION OF WASTE.

What can be done to save the enormous loss to the state is clear: The land must be restocked and the young timber must be given a chance to grow on all lands which are essentially forest soil and not desirable for agriculture.

*Forest Fires.*—What the fire has done to the pine supply is apparent from the conservative figures of original stand of pine. Besides this injury to pine, the fire has killed more than 5 billion feet of hemlock, at least 1 billion of cedar and several billions of hardwoods besides large quantities of tamarack. In addition fire has killed stands of young and sapling pine (under 8-inch diameter) covering many thousand acres, which today would furnish 5 billion and more of merchantable material. This same work of destruction continues; this very fall (1897) many hundreds of acres of young sapling pine were ruined by fire, and it will require many years before the opening of settlements and roads suffices to suppress the fire fiend. From this it is clear, and the fact is fully conceded by all persons conversant with the conditions of these woods, that the first and most important step in the right direction consists in the organization of an efficient fire police.

That a diversity of opinion should exist on this subject, is but natural. To most people the entire subject is foreign, the problem too large. To many even well informed and experienced men the forest fire is an enormous affair, a calamity which man is entirely unable to combat. Nevertheless, the best informed men, nearly all woodsmen ("cruisers" and loggers), whose opinion was sought in this connection expressed themselves in favor of such a police and felt certain of good result. In considering this important subject it may be of interest to point out a few fundamental facts which may help to shape a policy.

1. All fires have a small beginning. The Peshtigo fire, by far the most terrific ever experienced in Wisconsin, was known to be burning and gathering head for fully two weeks before it broke out in the final and then perfectly unmanageable form. The Phillips fire was heard and the smoke seen and felt in town for days before it reached the village and converted it into ruins.

2. All fires stop of their own accord after they have run for but a moderate distance, evidently finding obstacles which gradually reduce their power. The Peshtigo fire did not involve the fourth part of Marinette county; the Phillips fire not a fourth of Price, and a most intense fire in northern Chippewa county. which when at its best sent fire-brands across a lake over half a mile wide, did not keep on running, but stopped without going much, if any, beyond the county line.

3. The majority of fires are small fires. When the "whole

country is on fire" it is not one fire but hundreds of separate fires, all or nearly all of which have had their origin in carelessness.

4. It is carelessness and not malice, and it is more carelessness of letting fires go than of starting them which has resulted in the enormous losses.

5. Forest fires are diminishing in number as settlement progresses; every road, every clearing, helps to supply barriers, increases the number watching and fighting fires, and assists in the work of control.

6. Forest fires are both prevented and fought in the wild forests of India and in all parts of Europe; in localities where hundreds of acres of the young sapling pine with their fine largely dead and dried up branches (along the lower part of the stem), stand so thick that it is difficult to pass and where in addition poverty and chagrin among a dense population living close to the confines of the woods furnishes wilful and malicious incendiaries.

To the greater part of the opponents of such enterprise it may also be pointed out that for this country experience is as yet almost entirely wanting; that in New York, in Maine, and in Canada the fire police has done well and that it is impossible for anyone to say at present, just how successful the fire police of North Wisconsin will be. Even the little which has of late been attempted to educate, remind, and warn the people in matters of forest fires has already produced good results. The placards sent out by the State Land office, practically without cost to the state, have been extensively and judiciously placed, the people read them and mind them. In this connection it is to be regretted that the good attempts which have been made, especially by the lumbermen of the Menominee river, to introduce the burning over of the "works" or choppings throughout the woods, has not found favor and was abandoned. This process, experience shows, costs only 3 to 5 cents per thousand feet of logs and would practically put an end to the regular slashing fires. In the light of past experience it is clear to all that not only 5 cents but even 50 cents per M. feet could profitably have been devoted to the suppression of fire.

*Changes on Cut-Over Lands.*—The condition and character of the aftergrowth on cut-over lands is quite variable, since changes occur in the plant cover as well as in soil conditions according to original condition and subsequent treatment. These conditions and changes have a bearing on the question of the future of these lands, whether they be left alone or be restocked with timber, so that it appears desirable to give a description at least of the more frequent types.

*Sand Pinery Lands.*—1. When a clean dense stand of mature pine timber is cut, and the fire gets into the slashing late the following summer after all the limbs and tops on the ground have had a chance to dry, the ground is fairly cleared by the fire, the bulk of the tops are burned, a "stump prairie" remains. On the poor sandy soil whose small humus cover has been thus destroyed, there comes first a crop of fire weeds, then aspen and sweet fern, with other weeds, and some grass and isolated bushy scrub oaks (often some willows) cover the ground sparsely. As soon as enough dry leaves and other material have accumulated the fire recurs and the small aspen and other growth are killed. By this time the ground is much reduced in fertility, aspen is slower to return and the ground is largely taken by weeds and grass. A few repetitions of fire change the ground sufficiently to prevent the further growth of aspen for years and there are many areas where this tree has given up all effort to restock the land.

This seems to be the common form of slashing in heavy pine. Such areas furnish little foliage for live stock, they are naturally poor, and this condition is much aggravated by repeated fires and exposure to wind and sun. To an attempt at restocking with timber they offer no obstacle, save their poverty, which would soon be changed by growing timber.

If the fire is not repeated in such a slashing the aspen forms dense thickets in which pine, birch, and maple gradually find suitable conditions for their growth. For years the detrimental effect of the fire is visible in the stunted growth of the young trees; aspen, which in the original forest grow often several feet a year in height, remain short runts and it is not until ten and more years of rest from fire have permitted the accumulated litter to improve the soil, that a more vigorous growth becomes apparent. Tracts of this kind occur in every county, but they form only a small percentage of the total area of cut-over lands; they are troublesome to clear after the thickets once have attained considerable height and they furnish no good pasture. To continue them as woodlands they require merely protection from fire, and for their improvement pine should be supplied either as seed or plants wherever it is wanting.

2. Where the old stand of pine was broken, and a considerable mixture of small pine and hardwoods existed, there remains after the first fire a large amount of scorched and charred standing, dead and dying material. In this, as in the following form of cut-over pinery lands, young growth readily succeeds provided fires are not repeated. But this happy accident does not generally occur; the great quantity of dead material, most of which does not fall during any one year, keeps the ground furnished for several years with débris and thus invites the return of fires, which continue to come until the ground is largely cleared. The area now resembles the case first considered; it is a stump prairie, though usually not as clean. Here, too, the return of tree growth is very slow and often discouraged altogether for years.

3. Where groves of sapling pine have been culled of their larger timber and are then fired, the greater part of the remaining growth is injured and much of it is killed. These injured groves are generally of little promise in themselves; their growth is hampered, their scorched butts doomed to decay; but they are valuable in so far as they readily restock the ground with young timber, providing this is not killed by fire. If fire occur, which is the more common case, the entire grove is either gradually burned and killed, or if the fire gets in during a very dry season

and attains considerable proportions, the entire grove is changed at once into a tangle of scorched and charred poles, which require for their improvement either a great amount of labor and expense or else the starting of more fires to first get rid of the débris. Where fire runs through slashings (in large timber) too early in the season when the ground is still wet, and also where no fire occurs for several years after logging, so that the leaves have become litter, and the small twigs are decayed, then the slashings, even of wasteful operations where large amounts of heavy tops and much dead and down material exists, are often not burned clean and the ground is strewn with scorched logs and tops, and many cases exist where settlers are logging today on old slashings of this kind although not a living pine occurs.

It is but natural that these several forms grade into each other, and that nearly every slashing, especially during the first few years, markedly changes its complexion. In general the bare land form predominates in all pinery areas and occupies today probably about 70 per cent. of the cut-over lands.

*Loam and Clay Lands.*—4. A greater admixture of hardwoods, due to the presence of a larger amount of clay in the soil, materially affects the condition of the cut-over land. If pine was predominant and the hardwoods scant, as on the red clays about Lake Superior and on the poorer gravelly loam, the removal of the heavy stand of pine commonly involves almost a total destruction of the hardwoods just as in the case of the regular pinery; the ground is soon cleared by a repetition of fires, the aspen ceases to return. Unlike the sands, however, these loam lands soon produce a fair amount of grass and the land is converted into pasture.

5. Where the hardwood is heavier, and especially where hemlock enters into the composition of the forest, the dead timber remains standing for years. A forest of dead trees and often 400–800 cords of timber per acre may be seen after repeated and often severe fires have swept over the ground. Such areas are not rare; the fires of 1894 created quite a number. They are

undesirable pasture lands, difficult to clear and still largely too good to be restocked with timber, which in such places would require considerable labor and expense.

6. Where the heavy hardwoods and hemlock predominated and the pine was a mere scattered admixture, the ground and litter are usually damp, and fires run only during exceptionally dry seasons (as in 1894). The removal of the pine from these areas is not followed by fire; the lands are left densely timbered, so that they hardly seem to deserve the appellation of cut-over lands. Nevertheless, even in these forests fires have run, never far, to be sure, but still strips five miles and more in length are seen, where the fire has left a dense, heavy cover of dead and dying, scorched and charred trees of all kinds. Fortunately these tracts are not very numerous; their only hope lies in clearing them for farm purposes, for which nearly all of this heavier land is eminently well suited.

*Restocking.*—What may be done to restock the land will vary from place to place, according as the land is well under way to reclothe itself, or is a bare waste, or is a tangle of débris or covered with worthless thickets of fire damaged woods. This work may be done at once or by piecemeal, it may be done thoroughly or roughly, it may assist nature to a small or large degree. Where scattered saplings and defective trees have been left in logging and have survived the fires, these trees continue to seed the ground, around each of them a little crop of seedlings springs up after good seed years (every 3 to 5 years), and, if protected, these grow and in about 20 years, by the time the mother trees are gone, bear seed themselves and then really the process of restocking begins. Thus much valuable time is lost and the ground remains exposed too long to wind and sun and is thereby reduced in its fertility.

In many districts seed trees are wanting; repeated fires have killed both mother tree and seedlings, and nature must be assisted if anything is to be accomplished in reasonable time. In most sandy pinery lands where the fires have made a clean sweep, the work does not require much preparation, and a very cheap beginning can be made by planting a much smaller number (say, 500 per acre) than is really needed to make a satisfactory stand. These plants, together with the poplar, birch, and other brush, would soon make a cover for the ground, the young pine would rapidly be growing into marketable wood and at the age of twenty years and less would begin to shed abundance of seed so that before the first trees are ready to cut every foot of ground would be covered by a promising pine thicket.

Fire may have to be resorted to as a cheap and rapid means of clearing the ground where it is covered with large quantities of dead and fallen timber, and especially where dense thickets of fire-killed brushwood offer serious obstacles to any sylvicultural processes. The outlay for all work of this kind need be made but once; the forest once established will be permanent and by judicious logging and adequate protection against fire will renew itself indefinitely.

Of equal and perhaps greater importance than the choice of proper methods will be the selection of the proper kinds to plant. Among the native growth the pines are preferable to the hardwoods, and the white pine is foremost here as in every other respect. Nevertheless, red (Norway) pine and even jack pine will prove of great value and may often have to be resorted to. The value of these pines lies in part in their frugality, since they are perfectly satisfied with poor soils, really unfit for farming. They are still more valuable in their gregarious habit, thriving in great numbers together and thus facilitating exploitation, and in their capacity of developing a large number of trees on a small area. These powers, together with the great length of their trunk, causes them to produce large yields, and, finally, the character of their wood ensures for their product an almost unlimited market at all times.

The white pine will thrive on 90 per cent. of all sandy areas of Wisconsin and on all loam and clay lands, grows fast and in very dense stands, is useful for pulp at 30 years, for box boards at 50 and makes lumber at 80 to 100 years. According to the experience in Massachusetts and New Hampshire, groves 60 years old cut over 30 M. feet shook boards per acre, and furnish trees 12 to 20 inches in diameter and over 70 feet in height. These New England groves, which have largely sprung up on old abandoned farmlands and are generally without any particular management, are reported to furnish in the aggregate from 30 to 50 million feet per year.

Red (Norway) pine is even more frugal than white pine and there is no sandy area in northern Wisconsin which this tree can not cover with an abundant growth of fine timber. The jack pine is the most frugal tree of all and though of small stature and short-lived in Wisconsin, will prove a valuable aid in connection with the other pines and especially as nurse tree on the poorest sands.

To encourage the hardwoods will not be necessary except in some localities. Wherever abundant now they are growing well and are likely to be continued in the wood lot of the farmer on all clay and loam soils. It may safely be predicted that the hardwoods in the better hardwood counties will be abundant for many years. The hardwoods do not thrive on most of the land here considered "forest land," they refuse to grow on the sands, yield light and cut wastefully. They furnish a product, which however valuable intrinsically, will for a long time have to be contented with a limited and exacting market.

To those who are frightened at the mere idea of planting forests and who scorn European methods as impracticable in this country, the example of Saxony may be of interest. In that country the most intensive kind of forestry is carried on, so that an area of 400,000 acres (about 2-3 as large as Lincoln county) brings the state a net income of nearly 2 million dollars, and furnishes regularly to its consumers about 20 million cubic feet of wood per year, so that pulp mills and saw mills have long become permanent institutions.

The forests in this state are largely planted with nursery stock, yet the sylvicultural work of planting, sowing, etc., all told, amounts, on an average for the entire woods, to 10 cents per acre a year. This sum is only 6 per cent. of the total forest expenses, which include all logging operations.

We can not here consider whether all these efforts will pay as long as the land is held by private owners whose fortunes are only of today and whose heirs will prefer to parcel the land out to inexperienced settlers. The experience abroad and also in this country indicates that the state must undertake at least the most difficult and unprofitable parts of the work, and that the greatest good to the greatest number lies in state ownership of forests. New York waited a long time to see private owners manage rationally in its woods, but has found itself compelled at last to buy the land and to establish a forest organization to keep its mountains from being converted into desert brushlands and its streams from being alternately dry branches and mud torrents. A similar undertaking in Wisconsin would, at present, be greatly facilitated by the present conditions of ownership. The land is still held in large bodies and by men actively engaged in a business quite distinct from speculation and dealing in real estate, and therefore a transfer could in most cases very easily be effected and at prices (25 to 50 cents per acre) which would seem to guarantee financial success to forestry even in the backwoods of Wisconsin.

## RÉSUMÉ.

Briefly stated, the present conditions are as follows:

The State of Wisconsin, with a population of about 2 million, a taxable property of about 600 million dollars, has a home consumption of over 600 million feet B. M. of lumber, besides enormous quantities of other wood material, which, if imported would cost the State over 25 million dollars. Of its northern half, a land surface of over 18 million acres, only 7 per cent. is cultivated, the rest forming one continuous body of forest and wasteland. From this area there have been cut during the last 60 years more than 85 billion feet B. M. of pine lumber alone, and the annual cut during the past ten years exceeded 3 billion feet on the average per year.

The industries exploiting this resource represented in 1890 one-sixth of the total taxable property in the State, paid to over 55,000 men the sum of over 15 million dollars in wages, and the value of their products was equal to more than one-third the entire output of agriculture. Of an original stand of about 130 billion feet of pine, about 17 billion feet are left, besides about 12 billion feet of hemlock and 16 billion feet of hardwoods. The annual growth, which at present amounts to about 900 million feet and of which only 250 million is marketable pine and over 500 million feet hardwoods, is largely balanced by natural decay of the old, over-ripe timber. In almost every town of this region logging has been carried on and over 8 million of the 17 million acres are "cut-over" lands, largely burned over and waste. The wooded area proper is steadily being reduced by logging and to a smaller extent by clearing.

At present nothing is done either to protect or restock the denuded cut-over lands of which fully 80 per cent. are now unproductive wasteland and probably will remain so for a long time. This policy causes a continuous and ever growing loss to the commonwealth, which at present amounts to about 800 million feet per year of useful and much needed material, besides gradually but surely driving from the State the industries which have been most conspicuous in its development, depriving a cold country of a valuable factor in its climatic conditions and affecting detrimentally the character of the main drainage channels of the State.

To remedy this matter and stop the great loss, it will be necessary to adopt active measures both to protect and restock. Both these processes are adaptive and may be done with a variable degree of thoroughness and consequent outlay.

## FOREST CONDITIONS IN THE SEVERAL COUNTIES.

*Ashland.*—The northern one-fifth was formerly a pinery on red clay soil with a thin sprinkling of inferior hardwoods, some hemlock and occasional cedar and even tamarack on the more level areas. South of this a mixed forest of hardwoods, hemlock, and pine on gray loam and clay lands stocked both slopes of the range as well as nearly all parts south of the range. In places, especially along streams, pine was predominant, as was also the case on the small sandy tract along the Flambeau river in the southeast corner of the county. The pine timber along the lake, except that of the Indian reservation, is cut and the pine has been culled from most of the mixed forest and is estimated, all told, at only 300 million feet. Small patches about the mines have been cut clean of all timber. Generally the hardwoods and hemlock are culled and with a yield of 4 M. per acre amount to about 700 million feet of hemlock and 900 million of hardwoods, of which birch and basswood form fully 60 per cent., while oak is hardly of economic importance. Fires have injured Ashland county only in the pinery along the lake and thus even the swamps are fairly well stocked with cedar, tamarack, and some spruce.

*Barron.*—The northern one-third, a gray loam and gravel land, was stocked with a mixed forest of pine and hardwoods, the pine prevailing, except on the ridges of the northwestern part of the county. In the central part on a variable sandy loam, was a pinery with a thin mixture of hardwoods and occasional better hardwood bodies. (See "Soo" Line from Cameron west.) The southeastern one-fifth of the county was sandy and bore jack pine and oak openings. The pine is cut, except in the northern and northeastern towns; the hardwoods are culled and in nearly all parts of the county damaged by fire. The standing pine is in isolated bodies and is estimated at 150 million feet. The scattering bodies of better hardwoods are believed to represent a stand of about 250 million feet in which oak, basswood, birch, and maple enter in nearly equal proportions. The few swamps of this county are reported bare of merchantable timber in larger quantities. Large tracts of cut-over and burned land occur in nearly all parts.

*Bayfield.*—A belt of red clay, 6 to 10 miles wide, skirting the lake, is pinery with a light mixture of scrubby hardwoods and some hemlock. The southeastern one-third, occupied by the basins of the Nemakagon and White rivers, is a mixed forest of pine, hardwood, and hemlock on a gravelly gray loam; and the central and western part, a broad belt extending from T. 50, R. W. southwest into Douglas county, is a sandy jack pine and Norway pinery, with considerable white pine in places. The timber along the lake, except that of the Red Cliff reservation, is generally cut; it is also heavily cut into on White and Nemakagon rivers and along the Northern Pacific Railway. The present stand of pine is about 3,000 million feet, of which a large part falls to the regular pinery lands. In addition, there are about 400 million feet of hemlock and an equal amount of hardwoods, most of which is birch, basswood, and maple; the oak, though abundant as scrub wood, being scarcely represented as a real timber tree.

On some of the "barrens" or jack pine and bare sandy lands, no timber existed when logging began, but there is evidence that in former times they, too, were covered by a forest of larger timber.

The numerous swamps of the southeastern part of this county are fairly well stocked with both cedar and tamarack and also some spruce. The swamps of the estuaries along the lake are generally covered by heavy growth of cedar. Bare wastes of great extent occur in all localities where pine logging has been going on.

*Burnett.*—Nearly the entire county is a sandy jack pine and Norway pinery, dotted with regular "barrens" and island patches of better loam lands. In the northwest corner, north of the St. Croix river, is a tract of gray loam lands stocked originally with pine, lightly mixed with hardwoods. Along the south line of the county extends a body of loam lands covered in part by heavy and almost pure stands of hardwoods, only the sandy depressions bearing pine. The pine in this county is largely cut, the little hardwood damaged by fire and only jack pine occurs in extensive woods. The scattering pine is estimated at about 200 million feet and about 200 million feet of hardwoods are believed to occur in this county, besides some 300 million feet of jack pine, which sooner or later must become of value. The swamps are largely bare or else covered by a light growth of tamarack. A large part of this county is positively bare land, being devoid of any forest cover.

*Chippewa.*—The southwestern and south central one-fifth of the county is oak openings and prairie (extensively settled) in its western, and jack pine woods in its eastern part; the remaining four-fifths of the county are forest. Of this, the part east of the Chippewa river and small tracts along the river on the west side, are covered by a mixed forest in which hemlock and birch are abundant, except on the southeastern part of the county, where the birch and hemlock forest merges into an oak forest. In the timbered part of the county west of the river the hemlock is missing and birch much less common. Though the pine has been cut in all parts of this large county, there is still a considerable amount scattered and in isolated bodies which is estimated at about 500 million feet. The hardwoods have been cut into in the southeastern and also in the northwestern part and large tracts have suffered heavily from the fires of the large pine slashings following all the streams; the hemlock has been cut but little, but like the hardwoods, has been damaged by fire. The standing hardwood and hemlock yield about 5 M. per acre, the yield in the pure hardwoods of the western part being lighter. About 800 million feet of hemlock and about 1,100 million hardwoods are believed to exist in this county. In the hardwoods in the western and also the southeastern woods the oak is predominant, but on the whole forms little over 10 per cent., while basswood and birch form over half the total supply.

The swamps, extensive only in the northeastern part of the county, have been much run over by fires and are, therefore, very poorly stocked. Large areas of burned-over wastes occur along all the streams.

*Clark.*—The greater part is a level loam land area, formerly covered by a forest of hardwoods, mixed with a remarkably heavy stand of large white pine. Hemlock occurs only in the northeastern portion. The western and southern part is invaded by the sandy area covering Jackson and Eau Claire counties, and was formerly covered by a pine forest without hardwoods. The pine has nearly all been cut and was sawed at La Crosse and Eau Claire, and only about 200 million are believed to be still standing. The hardwoods are culled especially for oak and have suffered from fires. The remaining supply is estimated at only about 650 million feet, of which oak is still nearly 30 per cent., the remainder being chiefly basswood and elm. Clark county has few swamps and these are poorly stocked.

The greater part of the county today is still covered by culled hardwoods, much of it is settled and only the sandy pinery presents tracts of bare waste many miles in extent.

*Douglas.*—The northern one-third of this county is red clay land with pinery in which is found an unusual mixture for this State of pine (chiefly white pine), white and yellow birch, and other hardwoods commonly with more or less cedar and tamarack. South of this and extending south to the St. Croix river and east to the Brule river is a similar forest of pine with a somewhat heavier mixture of hardwoods, heaviest on the range, growing on gray loam land. The southeastern part, south and east of the St. Croix, is a sandy jack pine and Norway pinery with large jack pine woods following the river into Burnett county. The pine has been cut along the lake and also along the St. Croix river and the railways, but there is still a great deal of standing timber in large and small bodies, estimated to cut about 3,500 million feet. The hardwoods have been little invaded, but since they form here but a secondary mixture, they are largely killed by fire when the pine slashings are burned, as is well illustrated by the country about, and south of Superior. On Maple Ridge considerable hardwood is cut, and strangely enough, oak forms often as much as 25 per cent. of the yield. Scattering as they are, the hardwoods are still believed to be about 700 million feet.

*Dunn.*—Of the sandy eastern half the northern portion is jack pine woods and openings, the rest oak openings with real prairies. Of the western half the clay and loam land ridges were covered with almost pure hardwoods and the more sandy valleys were stocked with a mixed growth of large pine and hardwoods, the former often prevailing. The woods on Hay river partook of the regular pinery form and merged into the jack pine woods of the northeastern towns. The pine is practically all cut, though the scattering patches still amount to several million feet. The hardwoods are much interrupted by clearings, many tracts have been culled and even cut clean. The isolated tracts of hardwood, with a yield of about 4 M. per acre, are estimated to cut 400 million feet of which oak is 25 per cent., and basswood and maple form 50 per cent. The few swamps are generally bare of merchantable material. Large areas of bare wasteland occur in the jack pine district and may be seen along the railway between Wheeler and Summit. Many groves of fine young white pine are fast growing into timber about Menomonie.

*Florence.*—The greater part of this county was a mixed forest of pine, hardwoods, and hemlock on a gray loam, with smaller tracts of regular pine land, especially along the streams, and a larger tract in the northeastern part, where even jack pine woods covered considerable ground. At present the pine is largely cut, and only about 150 millions of feet are believed to exist in this county. The hardwoods and hemlock have not been cut except small patches about the towns, but have been injured in places by fire. With 4 M. feet per acre of both hardwood and hemlock, the cut of the latter is about 300 million feet and that of the former about 400 million feet, of which basswood, birch, and maple form 75 per cent., while oak scarcely occurs. The swamps are generally covered and swell the entire cut of timber by over 100 million feet. Burned areas occur in every town of the county, occupying 20 per cent. of the entire land surface. Here, as in other counties, they form a far greater proportion of the area than is usually supposed.

*Forest.*—The northwest quarter of the county is largely a flat, swampy pinery, the rest is a forest of mixed hardwood, pine, and hemlock, generally on gravelly gray loam. This mixed forest is interrupted and dotted with numerous bodies of pine lands, where the hemlock and hardwood almost disappear. The pine is mostly cut. It is claimed that about 500 million feet are still standing. The hardwoods and hemlock are unculled and but little hurt by fires except about the pine slashings. With 4 M. feet per acre of well stocked woods there are about 500 million feet of hemlock and 1,000 million feet of hardwoods, of which birch and basswood form about 60 per cent. As in the neighboring counties, a little red oak occurs in Forest, but is thinly scattered over the entire county and would hardly form more than 2 per cent. of the cut. Many of the swamps are open bogs, the rest are generally stocked and the swamp timber, cedar, tamarack, and spruce, amount to fully 300 million feet. Nearly all pine slashings are burned bare, so that a considerable amount of waste land occurs.

*Iron.*—The southern one-fourth is a flat, loamy sand pinery of the same nature and continuous with that of Vilas and the northeast corner of Price counties. The rest is a loam and clay area with a mixed forest of hardwoods, pine, and hemlock. On the range the hardwoods and hemlock predominate and pine is scattering, otherwise the pine forms a heavy mixture everywhere. The numerous swamps, especially abundant in the southern half of the county, are generally stocked with cedar, tamarack, and some spruce, and these woods also invade more or less the low, flat portions of the ordinary woods, which are not really swamp. At present the pine is cut from parts of all townships, some of them being pretty well cleaned out, and the standing pine timber is estimated at only about 400 million feet. The hardwoods and hemlock have been cut clean on a small area about the mines, but otherwise remain unculled and not badly hurt by fire. The standing hemlock is estimated at about 350 million feet, and the hardwoods at about the same. Of these birch, basswood, and maple predominate.

*Jackson.*—The western half is a sandy loam district almost entirely occupied by oak openings, mixed with some tracts of better soil with bodies of better hardwood timber. The eastern half is a level, sandy pinery with many swamps and no hardwood timber. This area furnished considerable pine, but is now largely cut and burned over, and only about 100 million feet of pine is claimed to be standing. Numerous small and large bodies of young sapling pine and also of jack pine interrupt the extensive bare wastes. The swamps which are generally bare of merchantable material, were formerly stocked chiefly with tamarack, but have been cleaned out by repeated fires.

*Langlade.*—This county is covered by a continuous mixed forest of hardwoods and hemlock in which pine occurred both scattered and in denser bodies in patches and belts, which unlike those of Marathon county, do not always follow the drainage courses. The pine is practically cut, though the scattered material is still estimated at about 150 million feet. The hardwoods are dense and heavy; their cutting has hardly begun, and fire has injured them but little, nor is it likely to do so in the future. The standing hemlock amounts to about 1,000 million feet, the hardwoods to 1,100 million feet. Birch, basswood, and elm in nearly equal proportions form about 80 per cent. of the hardwood, followed by maple and ash, and a very small quantity of oak. The swamps are generally stocked with cedar, tamarack, and some spruce. Larger bare areas occur along the Wolf river, and include in all parts only the pine slashings.

*Lincoln.*—A mixed forest of hardwoods, hemlock, and pine covers the clay and loam lands, or about 80 per cent. of this county. A small strip along the Wisconsin river and a broad V shaped tract spreading northward from below the junction of the Tomahawk and Wisconsin rivers are sandy pinery. The pine is generally cut, only about 100 million being in larger bodies, but there is a great deal of scattered pine which will bring up the total cut to at least 250 million feet. The hardwoods are as yet unculled, have suffered little injury from fire, and with the hemlock will cut 6 M. feet per acre of all well stocked land. This means a total cut of about 1,000 million feet of hemlock and an equal amount of hardwoods, in which birch, basswood and elm represent about 70 per cent., oak only about 3 to 5 per cent. The swamps are largely stocked with both cedar and tamarack and a little spruce, but many of them have been burned into or were entirely cleaned out. Cut-over, burned, or bare lands exist wherever pine was dense and in the aggregate amount to many thousand acres of the very kind of land least desirable for farming.

*Marathon.*—This county was a continuous mixed forest of pine, hardwoods, and hemlock, except the narrow border along the larger streams where pine prevailed. The pine is nearly all cut; the present stand is estimated at about 200 million feet, much of which is thinly scattered through parts of the mixed forest. The forest of hardwoods and hemlock has been heavily cut into for more than ten years; it is interrupted by large clearings, but has not been injured much by fire. The standing hemlock is estimated at about 1,500 million feet, the hardwoods at about the same amount. Of the latter, birch and basswood in nearly equal amounts, form 60 per cent., elm 20 per cent., and oak only about 5 per cent.

Marathon has little swamp, most pine slashings have been burnt over and since so much good land exists all about, they are generally wastes. Many groves of young white and Norway pine may be seen along the Wisconsin river. Though well settled and stocked with hardwoods which do not encourage fires, even this county in the dry season of 1894 suffered considerably from fires, a fact which emphasizes the need of organization for their prevention.

*Marinette.*—The greater part of this county is a pinery. Its territory is slightly invaded by the mixed forest of Florence and Forest counties along the county line. Isolated bodies of pine slightly mixed with hardwood and hemlock are scattered in parts of the pinery, particularly in the towns along the Menominee river. Formerly, a heavy stand of pine mixed with hardwoods occupied the part next to Green Bay. This latter area was burnt over during the Peshtigo fire of 1871 and is now bare or brush land with some settlement. Pine has been cut in every town in the county; the present stand is estimated at about 1,500 million feet. The light mixture of hardwood and hemlock is largely fire-killed wherever the pine has been cut; the green timber remaining is estimated at nearly 500 million feet, half of which is hemlock. Of the hardwoods, maple, birch, and basswood predominate, oak as timber being very scarce. In the brushland along the Bay, the white cedar is disputing the ground with poplar and white birch. Extensive tracts of jack pine occur in the central and southwestern part. Large burned-over wastes exist in all parts of the county.

*Oconto.*—Over nearly half of this county next to Green Bay, the variable sandy loam land was covered by a heavy forest of pine, mixed with hemlock and hardwoods. The central part of the county is a sandy belt of pinery land, continuous with the sandy pinery of Marinette and Shawano counties. The loam and clay lands of the northern one-fourth was stocked with a heavy mixed forest of hardwoods and hemlock, with pine either scattering or in small bodies. At present the lower part of the county is cut over, much of it bare and a large part settled. The pine is cut in nearly all parts, and only 65 to 75 million feet are claimed to be standing. The hardwood forest, in which the beech is conspicuous only on the lower sandy loam lands, still covers a quarter of the county and is estimated to cut about 500 million feet of hemlock and 400 million of hardwoods, principally birch, basswood, elm, and maple, considerable ash and little oak. The swamps of the lower part are burned over and extensively drained and utilized. Those of the north half are generally stocked, the cedar prevailing. Fine groves of young white pine are abundant in the southern towns.

*Oneida.*—Almost the entire county is a loamy sand pinery, in which good hardwoods and hemlock are practically wanting. A few isolated island-like bodies of mixed forest on heavier soil, a small tract in the southwestern and larger ones in the southeastern part of the county disturb the general uniformity. The pine has been cut along nearly all streams and railways, and the remaining timber occurs in interrupted stands and is estimated at 1,200 million feet, of which a considerable part is red (Norway) pine. Of about 60 million feet of hardwoods 40 belong to birch and basswood, the rest being elm and maple and very little oak. The hemlock is believed to cut about 20 million feet and is too scattering to be considered at present. The numerous swamps, formerly stocked with tamarack, cedar, and some spruce have suffered much from fires. Large tracts of burned over and bare land occur in all parts of the county and of the numerous pine thickets, which occupy thousands of acres, a great many have been injured and killed by fire.

*Polk.*—The northwestern corner from Wolf creek to the St. Croix river is sandy jack pine woods, which continue into Burnett county. The remainder of the northern half is generally a hardwood forest, quite pure on many of the ridges, mixed and often entirely displaced by pine in the sandier depressions and valleys. The southeastern portion, about two tiers of towns along the east line from the southern boundary northward, was pinery with light mixture of hardwoods and better bodies of hardwoods in places and the southwestern portion was jack pine and oak openings. The pine is mostly cut, the standing timber is in isolated bodies and is estimated at about 240 million feet. The hardwoods have been extensively culled except in the northern townships, where a stand of about 600 million feet is believed to exist. Of this, oak and basswood form over half, while birch is comparatively scarce. Polk county has few swamps and no large quantities of merchantable timber are claimed for these. Cedar is practically wanting. The jack pine woods are quite extensive and will yield a heavy cut. Bare areas are common here as in other counties. A few of these tracts are stocked with fair-sized poplar which on this sandy loam seems to thrive better than elsewhere.

*Portage.*—The southeast quarter is oak openings with groves of jack pine, especially in the western part. The southwest quarter is jack pine woods and in the southern portion, a marshy pinery, forming part of what is known as "Little Pinery." The northern half, broader on the western side, was a mixed forest of pine and hardwoods with some hemlock and was divided by strips of sandy pinery following up the Wisconsin and Plover rivers. Both pine and hardwoods have been cut in nearly all parts of the county, but there are still smaller bodies and scattering timber to warrant an estimate of about 20 million feet of pine. The hardwoods and hemlock, of which some fair bodies exist in the northeastern part of the county, represent a probable cut of about 150 million feet, 50 million being hemlock. The extensive and dense jack pine woods will furnish 150 million feet of material for special mills or pulp purposes and will in time prove of considerable value. The swamps, of which a large part are open marshes, have suffered much from fires. Large tracts of burned-over pine slashings exist throughout the lumbered part of the county.

*Price.*—The entire county is a level loam and gravelly loam area, formerly stocked with a most luxuriant mixed forest in which pine prevailed in most of the northern two-thirds and the hemlock and hardwoods in the rest. On a few small tracts, in the central part and also along the Oneida county line in the northeastern part of the county, a sandier soil gave rise to almost a pure pinery form of forest. The pine is generally cut, about 200 million are still believed to be standing, but most of this is scattered and not over half in large bodies. The hemlock and hardwoods in over half the county have suffered seriously from fires and over large areas have been killed entirely. Nevertheless, there are nearly 400,000 acres of wooded area which are believed to cut about 1,000 million hemlock and 900 million feet of hardwoods. In the latter birch and basswood predominate, with elm and maple following, both ash and oak being rather scarce. Price is one of the counties in which fire has done unusual damage and large areas are entirely bare of growing material.

*Sawyer.*—A mixed forest of pine and hardwoods covered nearly the entire county, with two exceptions: (1) a narrow strip along the Nemakagon river, which is a sandy jack pine and Norway pinery, and (2) a sandy pinery area south of Round lake from the Chippewa river west to the county line. The pine prevailed over considerable areas, as for instance, along the Chippewa and Flambeau rivers. Hemlock occurs only in the eastern two-thirds of the county, being rarely found west of Range 7 W. The pine has been cut along all the rivers, but there still remain large quantities, which in the aggregate are estimated at 2,000 million feet, and by some even at 2,500 million. The hemlock amounts to about 900 million feet, the hardwoods 1,000 million, of which fully half is birch and basswood and about 10 per cent. is oak, this latter occurring chiefly in the western part of the county. The 12 per cent. of swamp lands are generally stocked, though extensive damage has been done to those in the vicinity of pine slashings. Even in this county with little settlement, large tracts of burned-over lands are abundant.

*Shawano.*—The southeastern one-third of this county, with its variable sandy loam and loamy soil, was formerly covered by a heavy forest of pine, mixed with hardwoods. The country about lake Shawano and north to the county line is part of the sandy pinery district extending from this lake to the Menominee river. The northwestern two-thirds was a very heavy mixed forest of hemlock, hardwoods, and pine, growing on a good, though in places very strong, loam and slay soil. The pine is cut, except in the Indian reservation, where about 300 million are still claimed to be standing. The hardwoods and hemlock of the southeastern two-thirds are culled and damaged by fire, those of the northwestern half are largely intact and have been injured only about pine slashings. The standing hemlock is estimated at 650 million feet, the hardwoods at 760 million feet, of which basswood, elm, and maple form over 70 per cent., and oak only about 5 per cent. Beech occurs only in the sandy loam area. About 30,000 acres around Shawano are covered by young white pine, which has sprung up on old slashings. The extensive swamps of the southeastern part have all been burned over and many of them are being drained and cultivated. Those of the western half are largely stocked with cedar and tamarack, some of them yielding 15 M. feet and more per acre. Bare "stump prairies" occur in all parts of the county.

*Taylor.*—A continuous mixed forest of pine, hardwoods, and hemlock on a loam and clay soil covered the entire county. The pine has been cut, except small bodies in the southwestern part, estimated at about 200 million feet. The remaining forest still covers more than 60 per cent. of all wild lands and cuts about 6 M. feet per acre. In this forest hemlock is predominant, is estimated at about 1,500 million feet, some good authorities placing it at 2,000 million. The hardwoods are about 1,000 million feet, of which 70 per cent. is basswood and birch and only about 5 per cent. oak. The few swamps are generally stocked with tamarack, some cedar, and spruce. Owing to the dense, damp cover of the mixed forest, Taylor county has suffered but little from fires, and large areas of bare land are comparatively scarce.

*Vilas.*—A mixed forest stocks the better soils of the northern one-fourth of this county and forms some scattering island tracts; elsewhere it is an uninterrupted pinery, principally white pine with little Norway and hardly any jack pine, covering a rather level, loamy sand area dotted with several hundred lakes and numerous swamps. Pine lumbering began here along the Wisconsin river over 25 years ago, and the pine forest is cut into in almost every township. The present stand of pine is estimated at about 1,500 million feet, besides many thousand acres of sapling and young pine thickets which might soon grow into valuable timber. Both hardwoods and hemlock are rather scattered, except in some of the northern townships. The hemlock is estimated at about 120 million feet, the hardwoods, of which birch, basswood, and maple are most important, at about 150 million feet. Of the numerous swamps, which form over 20 per cent. of the area, many are open bogs, but the majority are stocked with tamarack and cedar and some spruce. Both in the swamps and the pine slashings, fire has made much havoc and large areas of bare stump wastes are abundant.

*Washburn.*—An area involving the northwestern one-third of the county with broad arms extending up the Totogatic and Nemakagon rivers into Bayfield and Sawyer counties is sandy pinery with large bodies of jack and Norway pine, mixed with white pine. The rest of the county, generally a gravelly gray loam, was covered by a heavy stand of white pine with a light mixture of hardwoods. The pine is generally cut; the present stand is estimated at 350 million feet. The hardwoods have suffered much from fires and over large areas not a foot of merchantable timber exists. The standing hardwoods are estimated at about 220 million feet, of which basswood, maple, oak, and birch in nearly equal proportions form about 80 per cent. No swamp woods of commercial importance are reported. Some of the largest areas of perfectly bare, cut, and burned-over lands in Wisconsin occur in this county.

*Wood.*—The north half of this county was covered by a heavy stand of white pine with a mixture of hardwoods, to which was added a sprinkling of hemlock along the north line. South of this the sandy loam and loamy sand area was covered by regular pinery, which gave way on the west side of the river to an extensive open marsh and cranberry bog dotted by sandy, pine covered islands. Extensive bodies of jack pine follow up the river into Portage county.

The pine has nearly all been cut, and the 100 million feet of standing pine assumed for this county are mostly scattering and sapling material. The hardwoods have long been culled in all parts of the county and not over 12 per cent. of the area, with a probable stand of of about 300 million feet is believed to remain. Of this hardwood over half is oak and basswood. The hemlock is confined to the northern towns and will cut about 50 million feet. Aside from the large open swamp in the southwestern part, there are comparatively few swamps in this county. Large cut-over and burned-over areas are numerous, and much land is stocked with culled woods furnishing ample fuel, etc. Some fine groves of young white pine may be seen along the Green Bay and Western R. R. near Grand Rapids.

# LIST OF PRINCIPAL FOREST TREES OF NORTH WISCONSIN.

(Arranged according to economic importance in the region.)

## I. CONIFERS.

### 1. PINES.

a. White pine (*Pinus strobus*) occurs in all parts of the territory, as scattering mixture in the better hardwood mixed forest of the heavy soils, predominant on lighter sandy and gravelly loams and as pinery proper on the extensive loamy sand areas. It is the largest and most valuable tree of the region.

b. Red pine (Norway Pine) (*Pinus resinosa*) grows on all sandy pinery areas, scatteringly in the southern, abundant in the northern counties. It does not mix with the hardwoods on clay land except near Lake Superior, is generally mixed either with white or jack pine, but in places forms pure stands of considerable extent. In value it ranks second among the forest trees of North Wisconsin.

c. Jack pine (*Pinus divaricata*) is a small tree, grows generally in thickets, either pure or mixed, stocks all poor sandy lands and unlike the other pines, it also occupies part of the openings. It is of limited economic value.

### 2. HEMLOCK.

Hemlock (*Tsuga canadensis*) grows on all clay and loam lands of the eastern half of North Wisconsin; is either mixed scatteringly or evenly with the hardwoods or else predominates in bodies of variable extent. The hemlock is a large tree, grows slowly, is easily killed, even by mere exposure, and is not reproducing itself well in most parts of this region. It is of greater economic value than is generally believed.

### 3. CEDAR.

Cedar—This tree, commonly called white cedar or simply cedar, should receive the name arborvitæ (*Thuya occidentalis*) to distinguish it from other cedars. It is a medium sized tree of the swamps and the moist portions of the upland mixed forests. It occurs in most counties and prevails in the swamps of the Green Bay region; a tree of considerable value.

### 4. TAMARACK.

Tamarack (*Larix laricina*) is the common swamp tree of North Wisconsin; it forms dense groves of pure growth, mixes with arborvitæ and spruce, remains small in the swamps of the "openings," but reaches a fair size (80 to 90 feet in height) in the swamps of the forest region proper; of secondary value.

### 5. SPRUCE.

Spruce—White spruce, cat spruce (*Picea canadensis*) and black spruce (*Picea mariana*) are small shrubby half trees on the moss-covered bogs, and small to medium-sized trees on the better timbered swamps and the more humid portions of the loam and gravel land mixed forests. No distinction of species is made in using the wood, the logger's distinction of white and black spruce referring to quality of wood merely. The spruce occurs in all parts but is most abundant in the northern and eastern counties.

### 6. BALSAM.

Balsam fir, commonly called balsam (*Abies balsamea*), is a small tree growing scattered in nearly all parts of the mixed forest.

## II. BROAD-LEAVED TREES (HARDWOODS).

### 1. BASSWOOD.

Basswood (*Tilia americana*) is a rather tall, long-shafted tree, common in all hardwood forests; one of the most useful and best developed.

### 2. BIRCH.

a. Yellow birch (*Betula lutea*) (also called erroneously "red birch," "black birch" and "white birch" when in the log to distinguish character of wood), is predominant in the hardwood forest within the hemlock area, grows on all loam and clay lands, but rarely enters the regular pinery. Though it is here assumed that the birch generally pronounced yellow birch is truly the *Betula lutea*, this cannot be considered as settled, since the imperfect botanical distinctions between *Betula lenta* and *Betula lutea* render it difficult, if not impossible, to distinguish these two species in the field.

How far the true sweet (or red) birch (*Betula lenta*) replaces the yellow birch is as yet not certain. The woodsmen do not distinguish, except by the wood, and thus their classification is mainly one of quality of timber and not of species.

b. Paper birch (*Betula papyrifera*), commonly called white birch, is not to be confounded with the true white birch (*Betula populifolia*) which does not seem to occur in this region and is a much inferior tree. The paper birch is the characteristic hardwood tree of the fresher sandy soils, is always small, grows best in the northern counties, does not thrive on the poorer sandy "barrens," occasionally forms small thickets, is generally mixed with pine and along Green Bay with arborvitæ. Like aspen, it enters extensively in the brush cover of many cut-over bare lands, but thrives only where considerable sand is present in the soil.

### 3. ELM.

a. White elm (*Ulmus americana*) is a tall, long-shafted tree common in all hardwood forests.

b. Cork elm (*Ulmus racemosa*), commonly called rock elm, replaces to quite an extent the preceding species in many localities, and probably forms near 30 per cent. of all elm of the region.

A "bastard" elm, with the foliage of white elm and the bark of cork elm, is often noted by the woodsmen.

c. Slippery elm (*Ulmus pubescens*) occurs sparingly in parts of this region.

### 4. MAPLE.

a. Sugar maple (*Acer saccharum*) is a common tree of all hardwood forests, and, to a very considerable extent invades with aspen and paper birch the regular pinery. Among the small, young growth of most hardwood forests it predominates in number.

b. Silver maple (*Acer saccharinum*), often called soft maple, is quite generally distributed throughout the mixed forest, as is also the

Red maple (*Acer rubrum*). The bush maples, spiked and striped maple (*Acer spicatum* and *Acer pennsylvanicum*) form a considerable part of the undergrowth in the mixed woods of the clay land.

### 5. OAK.

a. Red oak (*Quercus rubra*) is the common timber oak of the region and occurs in all counties, and on both sandy and clay soils, but is abundant only in the western and southern counties, and makes a good tree only on the heavier soils.

b. White oak (*Quercus alba*) occurs quite abundantly in the southern and southwestern counties, but is very scarce, in any form, in the greater part of the region. This is also true of the

c. Bur oak (*Quercus macrocarpa*). In the north central and eastern parts, in the upper Wisconsin, Menominee and Peshtigo basins the scarlet oak (*Quercus coccinea*) is generally the only "scrub oak"; it is scattered here over extensive tracts of sandy cut-over lands as a bushy tree or shrub. The "scrub oak" of the openings, along the southern and western edge of the region is formed of a variable mixture of all species of oak of the territory.

### 6. ASH.

a. Black ash (*Fraxinus nigra*) and

b. White ash (*Fraxinus americana*), the former by far the more common, are found in every county, are generally restricted to the swamps and on the whole form a very small portion of these woods either in number of specimens or as saw timber.

### 7. ASPEN.

a. Aspen (*Populus tremuloides*), very commonly called poplar.

b. Large-toothed aspen (*Populus grandidentata*) is very common in all parts of north Wisconsin; it is much more conspicuous on the cut-over lands as brushy cover, in the sandy pineries as scattered mixture, and also in the mixed forests of the Lake Superior region than in the better hardwood forest, where it forms but an insignificant proportion of the merchantable material.

Of the less conspicuous or less important forest trees must be mentioned:

Butternut (*Juglans cinerea*) scattered throughout the better hardwood forest.

Blue beech (*Carpinus caroliniana*) and hop hornbeam (*Ostrya virginiana*), both of which occur quite abundantly in all hardwood forests without ever forming merchantable timber.

Hickory, chiefly pignut, bitternut and mockernut (*Hicoria minima, glabra* and *alba*) occur in the southern districts and occasionally reach timber size.

Black cherry (*Prunus serotina*) rarely occurs on the better lands and cannot be considered as an important tree.

## SCHEDULE OF INQUIRIES ON FOREST CONDITIONS OF WISCONSIN; LINCOLN COUNTY.

[Filibert Roth, 1897.]

[References: H. W. Wright, John Woodlock, Herm. Rush, William Bradley, J. J. Hoffman, C. D. Clark, L. N. Anson, N. Emerson, and George Langley.]

### I. OWNERSHIP.

| | Acres. |
|---|---|
| Total area | 576,000 |
| Total area (Forestry Division) | 576,000 |
| Land surface (Forestry Division) | 572,000 |
| Land surface (U. S. Land Office Rept.) | 581,000 |
| Land surface (chief geographer, U. S. Geol. Survey in Census Bul., 1890) | 448,000 |
| 1. Actual settlers, farmers, etc. | [*]49,000 |
| 2. Private owners not occupying land | 447,000 |
| 3. Of this is owned by lumbermen 60 per cent. | |
| 4. Railway companies (Wisconsin Central Railway) | 41,800 |
| 5. Township | ...... |
| 6. County | 4,000 |
| 7. State | 19,440 |
| 8. Of this in bodies over 160 acres 66 per cent. | |
| 9. United States lands | 11,200 |

### II. GENERAL SURFACE CONDITIONS.

| | Acres. | Per cent. of total. |
|---|---|---|
| 1. Cultivated land | [†]9,000 | |
| 2. Forest and waste lands | 553,000 | 97 |
| 3. Virgin forests | 345,000 | 60 |
| 4. Virgin forests in tracts of over 160 acres | 345,000 | 60 |
| 5. Cut-over lands | 158,000 | 28 |
| 6. Swamp | 50,000 | 9 |
| 7. Lakes | 10,000 | 2 |
| 8. Land best to be left as forest | 145,000 | .. |

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[*] The U. S. Census, 1890, gives 63,481; the above is figure of state census, 1895.

[†] U. S. Census of 1890 gives this at 10,500; the above is State census.

### III. CONFIGURATION AND WATER COURSES.

1. Of total area, 20 per cent. long slopes; 10 per cent. hilly land; 55 per cent. rolling; 15 per cent. low flats.

Note.—No hills over 300 feet high; most large hills have long slopes; considerable "pot hole" land exists both in loam and sand land area. The entire county is drained by the Wisconsin and its tributaries, the Prairie, Pine, Spirit, Somo, Tomahawk, New Wood, and Copper rivers, all of which furnish good driving facilities.

### IV. SOIL AND DRAINAGE.

1. Strong clay, 20 per cent. of area; depth, great; color, gray; grain, fine, mixed with gravel and large stones. Loam, 60 per cent. of area; depth, great; color, gray; grain, fine, mixed with gravel and large stones. Loamy sand, 20 per cent. of area; depth, great; color, reddish gray; grain, medium, with little fine gravel.

2. Good farm land, 30 per cent. of area; drainage, good. Medium farm land, 45 per cent. of area; drainage, good. Forest soils proper, 25 per cent. of area; drainage good.

NOTE.—Many of the marshes make fine farm land.

1. Railways (names), Chicago, Milwaukee and St. Paul; Chicago and Northwestern; "Soo;" Wisconsin and Chippewa. Miles, complete, 82.

### V. FACILITIES FOR TRANSPORTATION.

2. Roads in good and bad condition, about 300 miles; roads not yet opened, about 1,500 miles.

3. Streams large enough to float timber, over 200 miles; useable, six months per year.

### VI. WOOD INDUSTRIES.

1. Pine mills cut in 1897, 120,000,000 feet; saw little hemlock or hard woods.

2. Tan bark, 30,000 cords hemlock.

3. Other woodworking establishments:

Merrill was the head of raft navigation, and lumbering began as early as the fifties.

In 1895 the product of the wood industries of Lincoln were valued at $2,350,000.

(To be amplified by census statistics.)

VII. MARKET. (g=unlimited; l=limited; n=none at all.)

White Pine stumpage, g; logs, g; lumber, g; firewood, l-n; mill refuse is used.

Norway stumpage, g; logs, g; lumber, g; firewood, l-n; mill refuse is used.

Hemlock stumpage, l; logs, l; lumber, l.

White Cedar stumpage, l; logs, g.

Tamarack stumpage, n; logs, l-n.

Oak stumpage, l; logs, l; lumber, g; firewood, l.

Elm stumpage, l; logs, l; lumber, g; firewood, l.

Basswood stumpage, l; logs, l; lumber, g; firewood, l.

Birch stumpage, l; logs, l; lumber, g; firewood, l.

Ash stumpage, l; logs, l; lumber, g; firewood, l.

Maple stumpage, l; logs, l; lumber, g; firewood, l.

Poplar stumpage, l; logs, l; lumber, g; firewood, l.

Chiefly Birch and Maple is sold for fuel.

Hemlock bark, good; Oak bark, none to be had.

Note.—Stumpage of hemlock and hardwoods has no ready market; it is sold for the labor of clearing, etc.; hemlock stumpage is being sold for bark purposes to a limited degree.

Two principal areas must be distinguished:

(1) The level and rolling clay and loam lands occupying about 80 per cent. of the county, and stocked with a mixed forest of hard woods, hemlock, and pine. The soil is generally a gray loam on a deep gray clay and loam; subsoil more or less mixed with gravel, and some stone of larger size. In places, as on nearing the rivers and also along the sandy area in the northern part, the soil becomes a sandy loam, usually with much gravel, and in other places, particularly the southwestern and western part, it is a heavy loam and clay. These differences in soil are reflected in the forest cover, almost pure hard woods occupying the heaviest clays and most fertile loams, a hemlock forest stocking the lighter gravelly loams and the pine predominating on the sandy stretches.

The pine is cut from nearly all parts of this area, but its removal has left the woods generally an undisturbed, dense, unculled, mixed forest of hard wood and hemlock, in which the former existence of pine is hardly noticed, since the humidity maintained, prevented both the starting and running of fires.

Narrow belts of sandy gravel and sand, along the Wisconsin and some of its tributaries, formerly stocked with heavy pine forests, now all cut and the slashings burned and largely waste. On some of these old slashings pine groves of young white pine may be seen.

2. A level sandy pinery area, occupying the northern part of the county east of R. 5 E., forming a broad V-shaped body, rapidly widening from its apex, below junction of Wisconsin and Tomahawk rivers, and extending into Oneida.

The soil and subsoil here is a light loamy sand of great depth, medium grain, and generally a reddish gray color, more or less mixed, locally, with a fine gravel. This area was densely covered by a forest of white pine, with about 20 per cent. Norway, and, locally, some jack pine. This is now practically all cut, and repeated fire have cleared the greater part of all forest cover, leaving the ground covered by brake, sweet fern, and bushy scrub oak and poplar, neither of which seems capable to form a tree under these conditions. A number of fire-damaged groves of sapling and small pine interrupt these tracts of barren lands.

## VIII. FOREST GROWTH.

A. Timber lands, i. e., from which little or no timber has been taken.

(*a*) Originally: Mixed forest, 75 per cent. of area, in which Pine, 40 per cent.; hard woods, 30 per cent.; Hemlock, 30 per cent. Pine woods, 14 per cent. of area; swamps, 9 per cent. of area; lakes and rivers, 2 per cent. of area.

woods, 14 per cent. of area; swamps, 9 per cent. of area; lakes and

(*b*) At present:

1. Hardwoods:

Of these, proportion in mixed forest—

Oak, 3 per cent., nearly all Red Oak; Elm, 20 per cent., nearly half Rock Elm; Ash, 5 per cent., nearly all Black Ash; Maple, 15 per cent.; Basswood, 25 per cent.; Birch, 30 per cent.; White Birch and Poplar, 2 per cent.

Size and quality vary with the soil. Maple is very abundant, but much is defective. Hickory, Blue Beech, Hop Hornbeam, and Butternut occur.

The standing pine suitable for ordinary logging is placed at about 75,000,000 feet. To this must be added large quantities of scattered material which is being logged, chiefly by farmers, in a small way, and which will swell the total cut easily to 250,000,000 feet B. M.

2. Mixed conifers, with or without hard woods, 345,000 acres; yield, 6,000 feet per acre; Hemlock, 50 per cent.; quality, good; diameter, 18 inches; height, 85 feet; hard woods, 50 per cent.; quality, common; diameter, 18 inches; height, 70 feet; Hemlock is good, cuts 2½–3 logs per tree, 10 logs per 1,000 feet; hard woods, short-bodied, 2 logs per tree, 6–8 logs per 1,000 feet; White and Norway Pine mostly cut.

Undergrowth and soil cover: Humus, not deep; moss, bare. The undergrowth is formed of young trees, Bush Maple, Hazel, Dogwood, also small Blue Beech, Hornbeam, and Balsam.

3. Swamp forests, 30,000 acres; yield, 3 M. feet, or 6 cords; Tamarack, 50 per cent.; height, 80 feet; diameter, 12 inches; White Cedar, 40 per cent.; height, 50 feet; diameter, 16 inches; Spruce, 10 per cent.; height, 50 feet; diameter, 12 inches. The swamps are generally stocked, many have suffered from fire, and many have trees of "all one size," and all too small to use, so that the yield, when large areas are considered, is not very great.

B. Cut-over lands, i. e., where most or all valuable timber has been removed.

1. Total, 158,000 acres.
2. Tracts owned in quantities of over 160 acres.
3. Land not burned over, but no merchantable timber left, 100,000 acres.
4. Land burned over recently and waste, 58,000 acres.
5. Land stocked with young growth of Pine, 10,000 acres.

·Of this—

White Pine, 80 per cent., with Poplar; Norway, 20 per cent., with Poplar; Birch and Poplar found on all slashings, but of no promise.

White Pine is 1 to 20 feet high, grows thriftily. Norway Pine is 1 to 20 feet high, grows thriftily. Some very promising little groves occur about Merrill.

6. On these lands there is generally much fallen timber of all sizes; the humus is burned off. The soil is covered with débris, poplar brush, and on sandy land by sweet fern and cherry. The chance of seeding is poor, often wanting over large districts. Danger of fire very great during every dry season. Help to fight fires is inadequate where most needed.

### *Products of lumber and saw mills of Wisconsin.*

[From Federal Census of 1890.]

| CLASS OF PRODUCTS. | 842 ESTABLISHMENTS REPORTED. | | |
|---|---|---|---|
| | Establishments reporting respective items. | Quantity. | Value. |
| Aggregate value of all products (*a*) | 842 | ............... | $51,908,767 |
| FOREST PRODUCTS: | | | |
| Saw logs for domestic consumption (feet, scaled measure) | 137 | 289,226,998 | $2,153,154 |
| Telegraph poles (number) | 123 | 5,189 | 3,706 |
| Fence posts (number) | 155 | 509,458 | 29,454 |
| Railway ties (number) | 174 | 353,139 | 52,272 |
| Piling (pieces) | 70 | 13,938 | 20,128 |
| Hewed timber (feet, board measure) | 1 | 40,000 | 600 |
| Round timber, for export (feet, scaled measure) | 2 | 390,000 | 2,691 |
| All other products which have not become the material of the mill | 74 | ............... | 99,352 |
| Total | .......... | ............... | $2,361,357 |
| LUMBER-MILL AND SAW-MILL PRODUCTS: | | | |
| Sawed lumber (feet, board measure) | 657 | 2,212,564,872 | $31,873,910 |
| Bobbin and spool stock (feet, board measure) | .......... | ............... | ............ |
| Furniture stock (feet, board measure) | 152 | 11,039,772 | 129,976 |
| Carriage and wagon stock (feet, board measure) | 152 | 4,171,461 | 52,436 |
| Agricultural implement stock (feet, board measure) | 127 | 855,632 | 10,936 |
| Pickets or palings (feet, board measure) | 116 | 32,885,699 | 150,818 |
| Shingles (number) | 371 | 1,366,022,000 | 2,186,643 |
| Staves (pieces) | 38 | 58,187,022 | 363,714 |
| Headings (sets) | 41 | 7,818,755 | 312,135 |
| All other products (including receipts from custom sawing) | 550 | ............... | 3,029,103 |
| Total | .......... | ............... | $38,109,671 |
| PLANING-MILL PRODUCTS AND REMANUFACTURES | 193 | ............... | $11,437,739 |

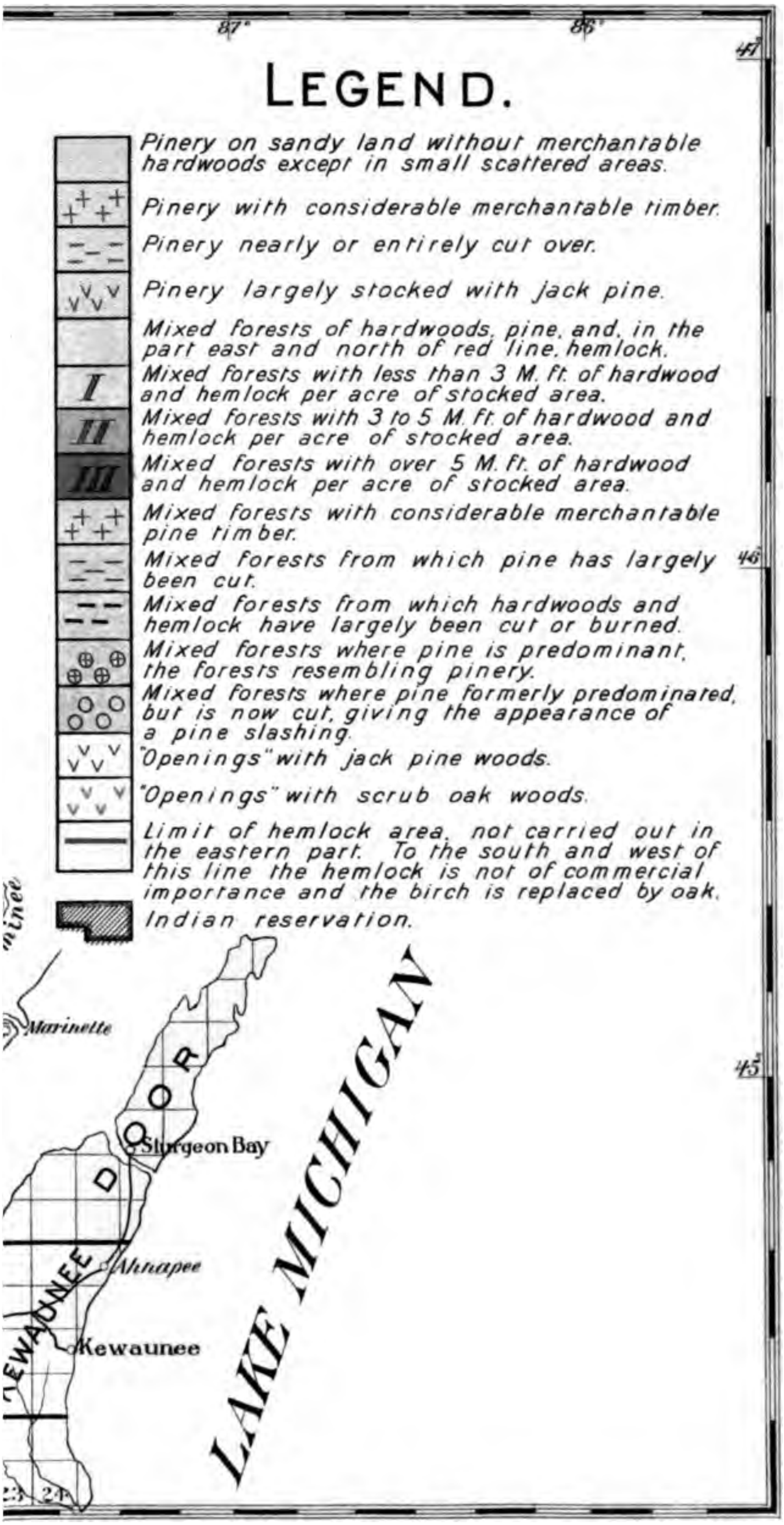
*a* The value of product is the net value at the mill, exclusive of expenses of selling. The cost of this item is stated under the head of "Annual expense charges," and should not be considered as a charge on the cost of manufacture.

| HEADING; CUSTOM SAWING, DETAILED. | Number of establishments. | Receipts from custom work. |
|---|---|---|
| Total | 525 | $823,079 |
| Establishments engaged exclusively in custom sawing | 94 | $430,847 |
| Establishments engaged partially in custom sawing | 431 | 392,232 |
| SPECIAL INDUSTRIES AND BY-PRODUCTS. | | Value of product. |
| Total | 45 | 2,206,024 |
| Handles, chair stock, and similar turned and shaped goods | 13 | 41,884 |
| Tubs, pails, churns, packages, miscellaneous, wooden ware, and veneers | 9 | 999,738 |
| Hoops | 3 | 28,655 |
| Paving blocks | .............. | .............. |
| Hubs, spokes, and similar wagon stock, in shape | 11 | 380,240 |
| Agricultural implement stock, in shape | 1 | 5,700 |
| Miscellaneous | 8 | 74,244 |
| Estimated value of laths | .............. | 550,000 |
| Estimated value of other by-products | .............. | 125,563 |

*Value of products of wood industries in the several counties of Wisconsin.*

[From the State Census of 1895.]

| Name of county. | Lumber, shingles and lath manuf'd. | Articles of wood manuf'd. | Wagons, carriages and sleighs manuf'd. |
|---|---|---|---|
| | 1,000 dollars. | | |
| Total for state | 34,437 | 19,234 | 5,300 |
| Ashland | 1,389 | .......... | 3 |
| Barron | 575 | 50 | 32 |
| Bayfield | 1,714 | 8 | 1 |
| Burnett | 13 | 8 | .......... |
| Chippewa | 317 | 239 | 5 |
| Clark | 325 | 371 | 10 |
| Douglas | 744 | 1,179 | 242 |
| Dunn | 1,025 | .......... | 4 |
| Florenc | 10 | .......... | .......... |
| Forest | 1,018 | .......... | .......... |
| Iron | 25 | 21 | .......... |
| Jackson | 24 | 6 | 5 |
| Langdon | 453 | 112 | 5 |
| Lincoln | 2,353 | 11 | .......... |
| Marathon | 2,000 | 711 | 13 |
| Marinette | 3,749 | 136 | 3 |
| Oconto | 746 | .......... | .......... |
| Oneida | 1,481 | 302 | .......... |
| Polk | 115 | 2 | 1 |
| Portage | 518 | 105 | 21 |
| Price | 492 | .......... | .......... |
| Pierce | 135 | 32 | 22 |
| Sawyer | 304 | .......... | .......... |
| Shawano | 351 | 5 | 5 |
| St. Croix | 702 | 41 | 1 |
| Taylor | 656 | 1 | 6 |
| Vilas | 2,035 | .......... | .......... |
| Washburn | 358 | .......... | .......... |
| Wood | 941 | 272 | 7 |
| Total for timbered counties | 24,568 | 3,612 | 386 |
| Brown | 1,227 | 277 | 24 |
| Eau Claire | 2,170 | 230 | 12 |
| Juneau | 137 | 2 | 7 |
| LaCrosse | 2,113 | 54 | 109 |
| Monroe | 237 | 2 | 4 |
| Outagamie | 83 | 260 | 14 |
| Waupaca | 998 | 56 | 9 |
| Winnebago | 1,082 | 3,920 | 349 |
| Total for counties directly dependent on the Wisconsin forests | 8,047 | 4,801 | 528 |
| Other parts of the state | 1,822 | 10,821 | 4,386 |



# LEGEND.

| | |
|---|---|
| | Pinery on sandy land without merchantable hardwoods except in small scattered areas. |
| + + + | Pinery with considerable merchantable timber. |
| – – – | Pinery nearly or entirely cut over. |
| V V V | Pinery largely stocked with jack pine. |
| | Mixed forests of hardwoods, pine, and, in the part east and north of red line, hemlock. |
| I | Mixed forests with less than 3 M. ft. of hardwood and hemlock per acre of stocked area. |
| II | Mixed forests with 3 to 5 M. ft. of hardwood and hemlock per acre of stocked area. |
| III | Mixed forests with over 5 M. ft. of hardwood and hemlock per acre of stocked area. |
| + + + | Mixed forests with considerable merchantable pine timber. |
| – – – | Mixed forests from which pine has largely been cut. |
| – – – | Mixed forests from which hardwoods and hemlock have largely been cut or burned. |
| ⊕ ⊕ ⊕ | Mixed forests where pine is predominant, the forests resembling pinery. |
| O O O | Mixed forests where pine formerly predominated, but is now cut, giving the appearance of a pine slashing. |
| V V V | "Openings" with jack pine woods. |
| v v v | "Openings" with scrub oak woods. |
| — | Limit of hemlock area, not carried out in the eastern part. To the south and west of this line the hemlock is not of commercial importance and the birch is replaced by oak. |
| ▨ | Indian reservation. |

The Wisconsin Geological and Natural History Survey was established by act of the Legislature in 1897. Its publications are issued as bulletins, which are numbered consecutively, and each bulletin is independently paged and indexed, no attempt being made to group them in volumes. The bulletins are issued in three series:

A. *Scientific Series.*—The bulletins so designated consist of original contributions to the geology and natural history of the state, which are of scientific interest rather than of economic importance.

B. *Economic Series.*—This series includes those bulletins whose interest is chiefly practical and economic.

C. *Educational Series.*—The bulletins of this series are primarily designed for use in the schools, and discuss the subjects of which they treat from this point of view.

The first bulletin to be issued belongs to the Economic Series, and is entitled: On the Forest Resources of Northern Wisconsin. F. Roth, Special Agent, U. S. Department of Agriculture. Pp. 78. 1 map.

The second economic bulletin is ready for the press, entitled: The Building Stones of Wisconsin. E. R. Buckley, Assistant Geologist on the Wisconsin Geological and Natural History Survey.

In the Scientific Series one bulletin has been issued (No. II.): The Instincts and Habits of the Solitary Wasps. G. W. Peckham and E. G. Peckham. Pp. 241. 14 plates, of which 2 are colored.

A second bulletin of this series (No. III) is in press.

A Contribution to the Geology of the Pre-Cambrian Igneous Rocks of the Fox River Valley, Wisconsin. Samuel Weidman, Assistant Geologist Wisconsin Geological and Natural History Survey.

In the Educational Series three bulletins are in preparation:

The Physiography of Southern Wisconsin. G. L. Collie, Professor of Geology, Beloit College.

The Physical Geography and Geology of the Dells of the Wisconsin and Devil's Lake. R. D. Salisbury, Professor of Geographic Geology, University of Chicago.

The Forest Trees of Wisconsin. L. S. Cheney, Assistant Professor of Pharmaceutical Botany, University of Wisconsin.

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